MACHINERY.

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THE DESIGN OF TUBULAR BOILERS.—2.

FACTOR OF SAFETY—METHODS OF BRACING.

CHAS. L. HUBBARD.

In designing a boiler, all its parts are made much stronger than is necessary for the working pressure. This margin is called the "factor of safety," and is the ratio obtained by dividing the ultimate or bursting pressure by the working pressure. A factor of 6 is usually taken, and this is advisable where the boiler is expected to be in use for a long time. A factor of 5 is often used, and even 4 where the boiler is carefully watched.

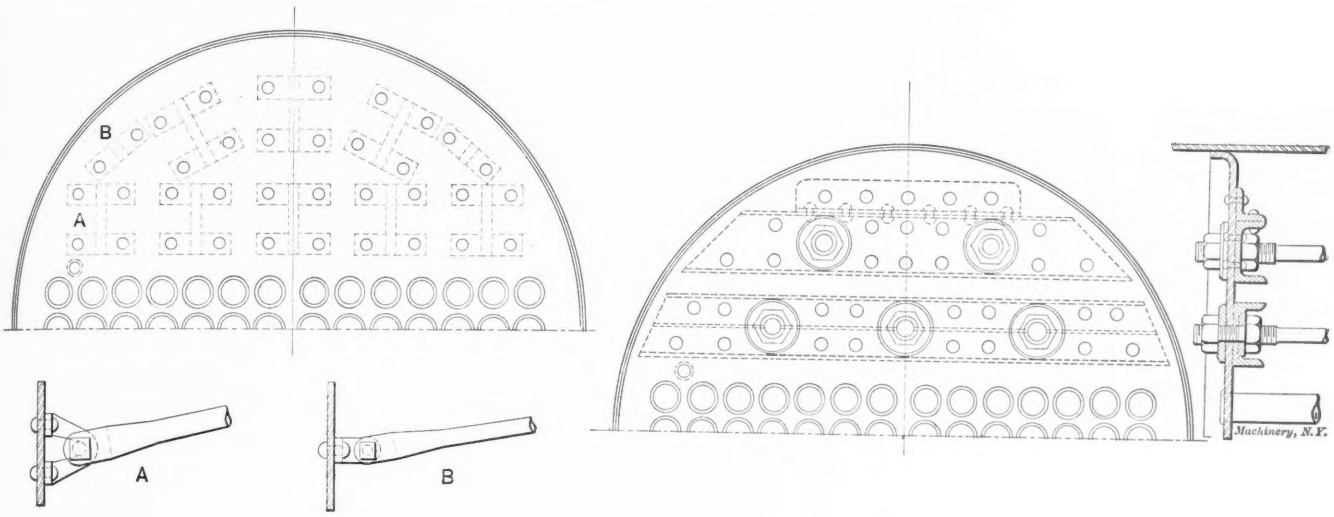


Fig. 5.

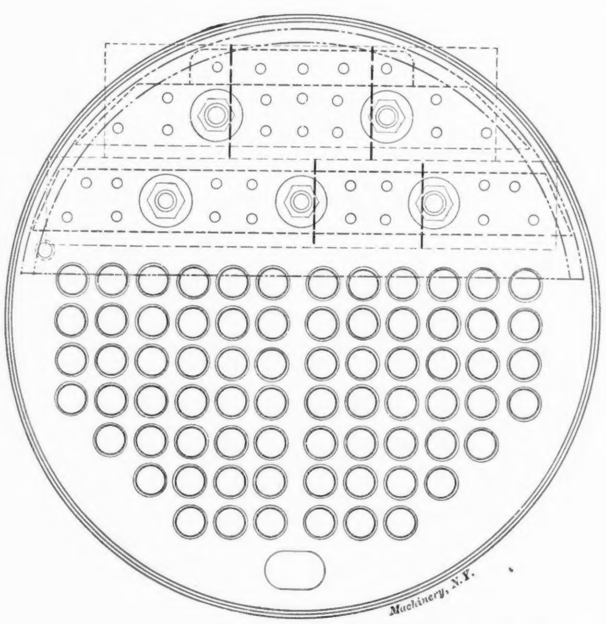


Fig. 6.

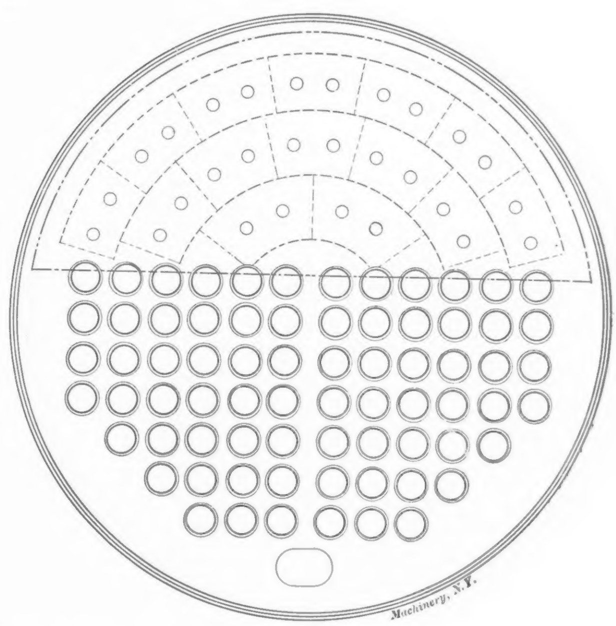


Fig. 7.

Details of Staying for the Heads of Steam Boilers.

Thickness of Shell.

If the shell of a boiler could be made of one continuous plate without seams, the ultimate or bursting pressure could be found from the equation:

$$P = \frac{t\,f}{R} \qquad (2)$$

in which

t = thickness of shell in inches.
f = tensile strength of shell, per square inch.
R = radius of boiler, in inches.
P = ultimate internal pressure per square inch.

In order to make this available for practical purposes, we must introduce a factor of safety and also the effect of riveted seams. Let

F = factor of safety.
E = efficiency of the riveted seam.
P' = working pressure per square inch.

We may then write:

$$P' = \frac{t\,f\,E}{R\,F} \qquad (3)$$

$$t = \frac{P'\,R\,F}{f\,E} \qquad (4)$$

$$R = \frac{t\,f\,E}{P\,F} \qquad (5)$$

Table XI. gives the working pressures for different diameters of boilers and types of joints, with varying thicknesses of plates and a factor of safety of 6. The efficiency of the joints is taken as follows: Single-riveted lap, 54%; double riveted lap, 70%; double riveted butt, 80%; triple riveted butt, 88%, and the results are given as the nearest multiple of 5, below the computed value.

The shell plates are usually made of "open hearth" steel, and the heads of flange steel, which is made with special reference to toughness and ductility. It is customary to make the heads from 1-16 to ⅛ of an inch thicker than the shell.

Table XI.

Diameter of Boiler.	Thickness of Shell	Type of Joint.			
		Single Riveted Lap	Double Riveted Lap	Double Riveted Butt.	Triple Riveted Butt.
30	$\frac{1}{4}$	80	105	120	135
	$\frac{5}{16}$	100	130	155	170
	$\frac{3}{8}$	120	160	185	205
	$\frac{7}{16}$	145	185	215	240
	$\frac{1}{2}$	165	215	245	275
36	$\frac{1}{4}$	65	90	100	115
	$\frac{5}{16}$	85	110	125	140
	$\frac{3}{8}$	100	130	155	170
	$\frac{7}{16}$	120	155	180	200
	$\frac{1}{2}$	135	180	205	225
42	$\frac{1}{4}$	55	75	85	95
	$\frac{5}{16}$	70	95	110	120
	$\frac{3}{8}$	85	115	130	145
	$\frac{7}{16}$	100	130	155	170
	$\frac{1}{2}$	115	150	175	195
48	$\frac{1}{4}$	50	65	75	85
	$\frac{5}{16}$	60	80	95	105
	$\frac{3}{8}$	75	100	115	125
	$\frac{7}{16}$	90	115	135	150
	$\frac{1}{2}$	100	135	155	170
54	$\frac{1}{4}$	45	55	65	75
	$\frac{5}{16}$	55	75	85	95
	$\frac{3}{8}$	65	90	100	115
	$\frac{7}{16}$	80	105	120	130
	$\frac{1}{2}$	90	115	135	150
60	$\frac{1}{4}$	40	50	60	65
	$\frac{5}{16}$	50	65	75	85
	$\frac{3}{8}$	60	80	90	100
	$\frac{7}{16}$	70	90	105	120
	$\frac{1}{2}$	80	105	120	135
66	$\frac{1}{4}$	35	45	55	60
	$\frac{5}{16}$	45	60	70	75
	$\frac{3}{8}$	55	70	80	90
	$\frac{7}{16}$	65	85	95	105
	$\frac{1}{2}$	75	95	110	125
72	$\frac{1}{4}$	35	45	50	55
	$\frac{5}{16}$	40	55	65	70
	$\frac{3}{8}$	50	65	75	85
	$\frac{7}{16}$	60	75	90	100
	$\frac{1}{2}$	65	90	100	110

Corrosion.

The weakest part of the shell, that is, the riveted joints, is the least affected by corrosion. This is especially true in those types which have covering plates, and for this reason quite an amount of corrosion may take place upon the solid plate before the actual factor of safety is changed.

Ring Seam.

Referring to equation 2, we have $P = \frac{t\,f}{R}$ or $f = \frac{P\,R}{t}$ which shows that in a cylinder subjected to internal pressure, the stress per square inch, in a section of the shell plate taken lengthwise, is equal to the internal pressure per square inch, times the radius of the shell, divided by the thickness of the plate.

Now let us take a cross section of the cylinder, and see how the stress corresponds with that just found, for the same internal pressure. The force tending to pull the shell apart is evidently equal to the area of the head multiplied by the internal pressure per square inch; or, expressed in the same symbols as the previous equations, the total pressure equals $3.1415\ R^2P$; and this is resisted by a ring of metal having a length equal to the circumference of the shell and a thickness equal to that of the plate. The resisting force will then be $3.1415\ 2R\ t\ f$. Placing these equations equal to each other, we have $3.14\,R^2P = 3.14\,2\,R\,t\,f$ or $f = \frac{P\,R}{2\,t}$ (6). This shows that the stress "f" is only ½ of that in a section taken lengthwise of the cylinder, so a ring seam having ½ the strength of the longitudinal seam will be sufficient. The lowest efficiency of a single-riveted joint, as already given, is 54%, while that of the triple riveted joint is 88%. This shows that the former is more than twice as strong as the latter, and that the ring seam may be single-riveted for all types of longitudinal seams within the limits given in Table XI.

Bracing.

This is an important matter and cannot be taken up as fully as would be desired, in an article of this length. The two methods most commonly used are known as "crow foot" bracing and "through" bracing. These are shown in Figs. 5 and 6. In the first method, the stays are provided with a fork at one end, and are fastened by means of a pin to a special forging called a "crow foot," which is riveted to the boiler head. The other end of the stay is flattened and riveted to the boiler shell. A crow foot having four rivets is called a double crow foot (see A, Fig. 5); and one having two rivets is called a single crow foot (see B, Fig. 5). Both of these are shown in plan on the leading page, Fig. 5.

The angle which the stay makes with the shell should not in general be much over 20°. As this form of stay has a forged end, it should be made of wrought iron, and should not be allowed to carry a load of more than 5,000 pounds per square inch in the direction of its length. As the stay is carried back diagonally from the head to the shell, the load which it supports perpendicular to the head is less than that along the axis of the stay. If it makes an angle of 20° with the shell, the supporting force at the head is only .94 of that carried by the stay in the direction of its length. It is not well to make this form of stay over 1¼ inches in diameter, as larger rods may bring too great a local stress where they are riveted to the heads. The rivets used for fastening the crow feet to the boiler heads should never be less than ¾ of an inch in diameter, owing to initial stresses caused by riveting while hot, and the working tensile stress, in any case, should not exceed 6,000 pounds per square inch of section. The pin or bolt is made of steel, and the following sizes may be used with wrought-iron rods of different diameters:

Table XII.

Diameter of Rod.	Diameter of Pin.
¾	¾
⅞	¾
1	⅞
1⅛	⅞
1¼	⅞

The rod may be riveted to the shell with two steel rivets of the same size as the pin. No forging used should be subjected to a stress greater than 5,000 pounds per square inch of section. The number of stays required depends upon the diameter of the boiler and the pressure to be carried. The area to be supported is taken as that bounded by a line drawn through the upper row of tubes, at a distance equal to ¼ their diameter, from the upper edge, and by a second line 1¼ inches from the inside of the shell. This surface is divided into sections of suitable size and a crow foot riveted to the center of each. Fig. 7 shows a common arrangement for a 60-inch boiler having 14 single crow foot braces for each head. The dotted lines show the areas carried by each brace, and the broken lines, the total surface to be supported.

The area carried by any rivet or support is considered as that bounded by lines drawn half way between the given point of support and the adjacent ones on all sides. This should be borne in mind during the discussion on "through" bracing to be taken up later. The maximum distance between the rivets is limited by the equation

$$S = \sqrt{\frac{9\,f\,t^2}{2\,P}} \qquad (7)$$

in which

$S =$ maximum distance between rivets or points of support, in inches.

$f =$ stress per square inch in plate (and should not exceed 7,000 pounds for mild steel).

$t =$ thickness of plate, in inches.

$P =$ internal pressure per square inch.

In locating the stays, they should be so placed that the rivets do not come nearer than 3 inches to the shell, otherwise grooving is likely to take place.

This form of bracing gives easy access to the boiler for inspection, and is quite widely used for heating work where moderate pressures are carried. For power work, "through" bracing is preferable, as the stays may be set to bear an even tension and, being without welds, steel can be used, which has a

much greater strength than wrought-iron and reduces the required size nearly one-half.

"Through" Bracing.

In this form of support, channel or angle iron bars are riveted to the boiler heads (see Fig. 6), the maximum distance between rivets being determined by equation 7. The channels in turn are supported by stays or bolts running through the boiler from end to end. Heavy nuts and washers are provided on the outside and check nuts upon the inside, as shown in the section view, Fig. 5.

The method of calculating the sizes of stays and channel bars is taken largely from "Steam Boilers" by Peabody and Miller, and is given by permission of the authors.

The total area to be supported is taken as before. Fig. 8 shows a common arrangement of channel bars and stays for boilers from 54 to 72 inches in diameter. The lower stays are equally spaced and the distance from the shell is made the same as that between the stays. The upper stays should be far enough apart to admit the body of a man; 15 inches being the minimum usually allowed.

The width of channels used depends upon the diameter of shell and the number of tubes. In boilers designed by the author, 7-inch channels were used for 72- and 66-inch boilers; 6-inch channels for 60- and 54-inch boilers, and 5-inch channels for boilers 48- and 42-inches diameter. The 48- and 42-inch boilers were provided with 4 stays instead of 5, as shown in Fig. 6.

Lower Stays.

The load carried by the lower stays is taken as that due to the pressure on the strip, bounded on the bottom by a line drawn half-way between the lower line of rivets in the lower channel

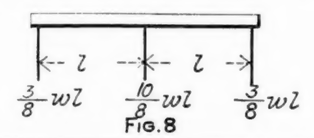


FIG. 8

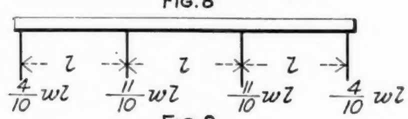


FIG. 9

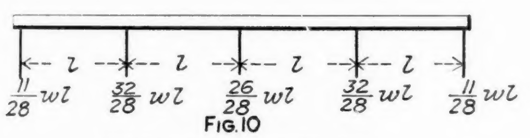


FIG. 10

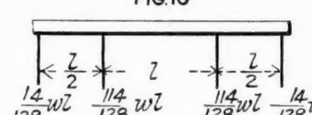


FIG. 11

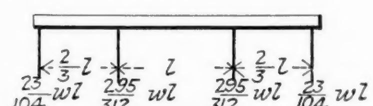


FIG. 12

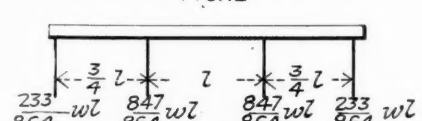


FIG. 13

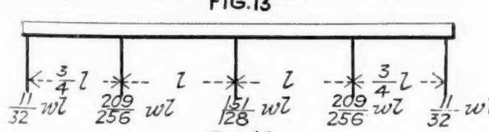


FIG. 14

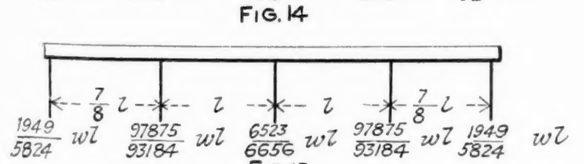


FIG. 15

and the broken line through the upper row of tubes; and bounded on the top by a line half way between the upper line of rivets in the lower channel and the lower line in the upper channel. (This is shown by the dotted lines.) It is assumed that this load has 5 supports. The ends are carried by the shell and the central portion by the three stays. The magnitude of the load on each support depends upon the spacing, and can be determined from one of the formulae for "Continuous Girders" given below, in which "w" = the load per inch in length on the strip, and is the vertical height in inches multiplied by the internal pressure per square inch. The distance, l, is also taken in inches.

Formulae for "continuous girders" are given here, showing the distribution of the load upon the various supports for different methods of spacing.

Upper Stays.

The load here is that due to a pressure on a segment bounded on the bottom by the upper edge of the lower strip and over the top by a line half-way between the arc, 1¼ inch from the shell and the outer rivets in the upper channel. The area of this segment is computed, and a rectangle of equivalent area constructed; the length of the rectangle being made equal to that of the center line of the upper channel.

The loads upon the stays are then computed as before, choosing the formula corresponding most nearly to the given spacing of supports. This done, select the stay carrying the greatest load and give it such a diameter that the stress shall not exceed 1-6 the ultimate strength of the material used. This may be taken as 9,000 pounds per square inch for mild steel. Table XIII. gives useful data for proportioning boiler stays.

Table XIII.

Diameter of Rod in Inches	Sectional Area, in Inches.	Ends Upset to	Threads per Inch.	Weight per Linear Foot.
¾	.4418	1	8	1.473
⅞	.6013	1¼	7	2.004
1	.7854	1⅜	6	2.618
1⅛	.9940	1½	6	3.313
1¼	1.2272	1⅝	5½	4.091
1⅜	1.4849	1¾	5	4.950
1½	1.7671	2	4½	5.890
1⅝	2.0739	2⅛	4½	6.913
1¾	2.4053	2¼	4½	8.018
1⅞	2.7612	2⅜	4½	9.204
2	2.1416	2½	4	10.47
2⅛	2.5466	2⅝	4	11.82
2¼	2.9761	2⅞	4	13.25
2⅜	2.4301	3	3½	14.77

* * *

MECHANICAL HEATING AND VENTILATION.

The blower system of mechanical ventilation and heating, which is being used so extensively for heating and ventilating machine shops, as well as other buildings, has advantages that seem to commend it to an increasing number of users. The particular features of this system are summarized in a concise manner by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Co., as follows:

"The entire heating surface is centrally located, enclosed in a fire-proof casing, and placed under the control of a single individual, thereby avoiding the possibility of damage by leakage or freezing incident to a scattered system of steam piping and radiators. The heater itself is adapted for the use of either live or exhaust steam, and provision is made for utilizing the exhaust of the fan engine, thereby reducing the cost of operation to practically nothing. At all times ample and positive ventilation may be provided with air tempered to the desired degree. Absolute control may be had over the quality and quantity of air supplied. It may be filtered and cleansed, heated or cooled, dried or moistened at will. By means of the hot and cold system, the temperature of the air admitted to any given space may be instantly and radically changed without the employment of supplementary heating surface.

The pressure created within the building is sufficient to cause all leakage to be outward, preventing cold inward drafts and avoiding the possibility of drawing air from any polluting source within the building itself. By returning the air, using live steam in the heater and operating the fan at maximum speed, a building may be heated up with great rapidity, as is usually desirable in the morning.

The area of heating surface is only one-third to one-fifth that required with direct radiation, while the primary cost and operating expense of a fan is far less than that of any other device for moving the same amount of air.

AMONG THE SHOPS.

NOTES FROM TWO BOSTON SHOPS—THOSE OF THE BALL BEARING CO. AND EDWIN E. BARTLETT.

THE BALL BEARING CO.

The group of views on this page shows some of the interesting things to be seen in the shops of the Ball Bearing Co., Boston, Mass. This company have built up an extensive business in the manufacture of ball and roller bearings within a comparatively short time, being established in 1894. They were among the first to engage in the business, and deserve credit for the enterprise shown in overcoming difficulties of design and manufacture and also a not altogether unfounded prejudice against anti-friction bearings applied to machinery in general. The history of the roller bearing is one of repeated failure until the introduction of improved machinery and methods of manufacture, together with an important feature of design. Without the cage for keeping the rollers in alignment with the shaft, the

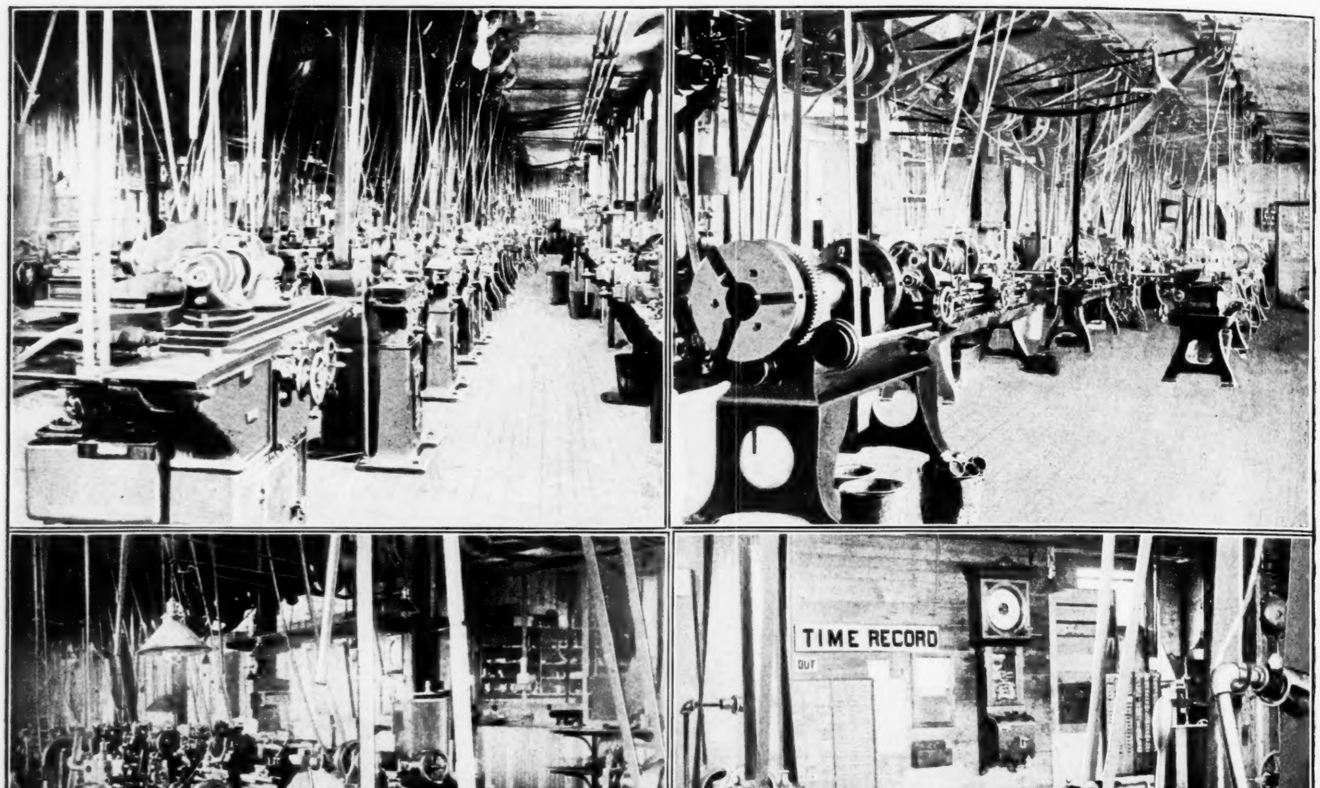


Fig. 1. The Grinding Machines.
Fig. 2. Looking Across the Shop.
Fig. 3. Roll Polishing Machine.
Fig. 4. Machine Department.
Fig. 5. "The Time and Cost Clerk."
Fig. 6. Drafting Room.

VIEWS FROM THE WORKS OF THE BALL BEARING CO.

roller bearing is an indifferent success. Another point often lost sight of is that ball and roller bearings have a speed limit above which it is not safe to go as, at high speeds, the balls or rollers will not attain the peripheral velocity of the rotating shaft, and as a consequence sliding action accompanies rolling, which soon wears flat spots on the rolls and ruins the device. The safe peripheral speed at which a roller bearing can be run is, at a conservative estimate, about 200 feet per minute. This constant holds good for either large or small shafts, and in any design it should not be exceeded, if satisfactory results are to be expected.

Roller bearings will not work satisfactorily on soft steel or cast-iron surfaces when subjected to heavy pressures, so the practice of the Ball Bearing Company is to construct their roller bearings with both a sleeve and a case, both made of hardened steel. The sleeve is slipped over the shaft of the machine for which it is designed, and the case is fitted in the box. It is thus evident that the work of making roller bearings on a commercial scale calls for a shop equipment capable of doing the most accurate work on hardened steel which, of course, means that the sleeve and case of every bearing are accurately ground on a grinding machine.

A view of the grinding department is shown in Fig. 1, which gives the reader an idea of the number of machines employed. One of the most interesting features of the grinding department are the machines equipped with the Walker magnetic chucks for holding pieces like discs and rings needing grinding on the faces. Eight grinding machines are fitted with these chucks,

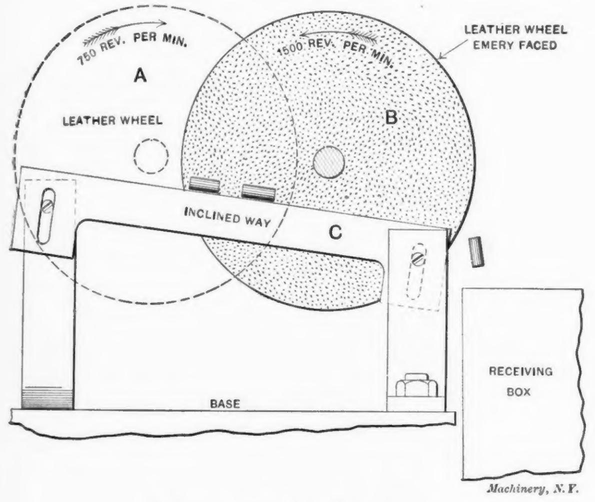


Fig. 7. Roll Polishing Machine.

the second in the foreground of Fig. 1 being one of the group. One man attends to the group with comparative ease, the pieces being chucked and removed without stopping the machines. The current is broken when the piece is removed, but there is always sufficient residual magnetism to hold the piece in place until removed and to hold the fresh piece until it runs truly, being lightly tapped as it turns until concentric, when the current is turned on to hold it firmly in position. The faces of the chucks are ground off once a week to keep them true. It is difficult to conceive a device better adapted to this work than the magnetic chuck. The only drawback to its extensive use is that it is strictly limited to the magnetic metals and cannot, therefore, be used on brass or copper.

Heavy turret lathes are used in the production of the smaller cups, cases and sleeves. The term "smaller" is used in a strictly relative sense, and does not necessarily mean that they are minute when it is known that the company have made roller bearings for 11" shafts, the outside diameter being 15¾". A double-turret Garvin machine is one of the important factors in economical production of heavy motor vehicle cups, having a record of 128 complete cups in one day.

The manufacture of hardened sleeves and cases as large as the one mentioned is necessarily attended with considerable risk, as they are quite likely to spring in the case-hardening furnaces, unless carefully attended, and thus be so distorted that they will not true up in the grinding machine. There is also an amount of shrinkage to be allowed for, which is found to be a variable factor depending on the quality of the steel. Of course an excessive allowance eliminates the risk of having a piece spoiled by the case-hardening process, but it entails a cost for grinding that becomes prohibitive. The consequence is that the construction of heavy bearings calls for considerable experience and skill to obtain commercial results.

One of the novel machines used in the production of roller bearings is the roll-polishing machine designed by Mr. Chadwick. Its general appearance is shown in Fig. 3 and its principle in Fig. 7. Two leather disc wheels are mounted on parallel shafts, one slightly ahead of the other, so that their faces are held a short distance apart. The wheels overlap on each other nearly one-half the diameters and are belted to the countershaft so that they run in opposite directions. The plain leather wheel A runs at 750 revolutions per minute, and the emery-faced wheel B, at twice this rate and in the opposite direction. The wheel A is mounted on a shaft which can move endways in opposition to a coil spring. The spring gives the necessary pressure for the polishing process. A steel bar is held between the two wheels in an inclined position by two uprights secured to the base. The bar is slotted at the ends so that the degree of inclination can be changed to suit the size and length of the rolls. In operation, the small rolls are shoveled into a hopper (not shown) and are whirled through the machine into the receptacle at the rear, at a rate of about 5,000 per hour. The larger and longer rolls require to be fed singly and the polishing process is therefore slower, being about 500 per hour.

One of the specimens of large thrust bearings shown to the writer was one made for the United States Government to support the revolving lantern in a lighthouse. The hardened steel discs of this bearing are 14" in diameter and about 1¼" thick. A brass plate between the two discs carries the balls, of which there are 93 in number, each 1" in diameter. The brass plate is solid and about ⅞" thick, and consequently quite heavy. To eliminate the sliding friction due to its weight, it is carried on a small supplementary thrust bearing of standard design. A feature of construction is that the holes for the balls are drilled through the brass so that a ring of metal is left on one side around each hole, which prevents the balls dropping out when that side is down. By this simple and cheap expedient the process of assembling such a bearing is considerably simplified.

The view shown in Fig. 5 shows what Mr. Rogers aptly calls the "Time and Cost Clerk," being the most essential part of his automatic system of time and cost keeping.

While this unique and simple cost system is probably more or less familiar to many readers, the subject is well worthy of a brief description of the shop end. Its essential features, as intimated, consist of the time-recording clock, together with the double card racks shown at the sides. The system is so devised that the clock not only performs the function of registering each man's time for the day, the same as any ordinary checking system, but also gives a record by which the exact time to a minute is shown for each job. The time for the day is registered on white cards. The cards for registering the time for specific operations are known as "cost" cards, and are red in color. The racks for the cards have numbered pockets, each number representing a workman. The two outside racks of each case are for the white or pay-roll cards, and the inner two racks are for the red or cost cards. The case at the left of the clock is labeled "Out" and the one to the right "In." Otherwise they are duplicates in all respects.

When a workman arrives in the morning, he checks in by taking his pay-roll card, page 70, from the "Out" case and placing it in a slot at the bottom of the clock, which automatically registers the exact time by the movement of a small handle. The card is then deposited in the "In" case at the right of the clock. The card, as shown by the reproduction, covers a period of one week. For time at nights and for lost time during working hours, separate columns are provided, headed "Out" and "In." At the same time the cost card is registered "In" and deposited in the "In" case at the left. If during the day the factory order called for by this card is finished, it is removed from the "In" case, the time registered, and then deposited in the "Out" case. The cost card therefore bears a record of the time to be charged against the factory order which, together with the workman's rate of pay, gives the nominal labor cost for the

job. In order to have the pay-roll time correspond with that recorded on the cost cards, it is necessary for the foreman to have another job for each man as soon as he has finished with the one in hand, a condition that continually spurs him to lay out the work ahead.

The workman has thus no clerical work to perform, neither has he to trust to a sometimes uncertain memory as to the time devoted to a certain job. The foreman's work also is of the most simple character. On the front of the cost card he has merely to inscribe the factory order number, a line under the kind of work, the number of pieces and the distinctive parts. When finished, it is so marked and signed at the bottom; on the opposite side the workman's number is entered at the top, and the remainder, as far as the shop is concerned, is taken care of by the recording mechanism of the clock.

A comparatively short time each day is required in a shop employing 60 men for a clerk to verify the cost and pay-roll cards, to see if the time registered on each agrees and for the general distribution of the cost among the various orders in proportion to the value of each workman's time. The further details of the system are out of the province of the shop and of the limits of this description. It may be added, however, that it reduces keeping the cost of factory operation to a science, leaving nothing to guesswork and that with a minimum of expense for clerical hire. A factory production statement is made out each month which shows exactly what unfinished orders have cost to date, and also the cost of all finished orders during the month. The simplicity of the system is such that a statement can easily be made at any time with a day's notice. It can be adapted to day work, as exemplified by this shop, to piece work or the premium plan, but the preference is given, by the originator, to day work, as he believes this system eliminates the factors which make day work unsatisfactory. The accurate record afforded of each workman's performance together with that of the foreman, as shown by net results, keeps the superintendent perfectly in touch with the entire working corps.

Form No. 7.

Week ending, Sept. 18 1899

No. 52

Name.

Powers

Day		In	Lost Time Out	Lost Time In	Out	Total.
M	A. M.	6 58/59			12 1/2	
	P. M.	12 55/56			6 00/1	
T	A. M.	7 00/1			12 2/3	
	P. M.	12 58/59			6 4/5	
W	A. M.	9 00/1			12 00/1	3
	P. M.	1 00/1			6 3/4	
T	A. M.	6 57/58			12 00/1	
	P. M.	12 55/56			6 6/7	
F	A. M.	6 58/59			12 3/4	
	P. M.	12 50/51			6 1/2	
S	A. M.	7 00/1			12 1/2	
	P. M.	12 52/53			3 1/2	2
S	A. M.					
	P. M.					

Total Time, 55 *hrs.*

Rate 12.00

Total wages for week, $ 11.00

Face of Time Card; Color, White.

WORKING TIME

OF

No. 52

Name,

Powers

This Side Out.

Foremen only must fill out a COST CARD for every job, and before the workman begins work on it.

The workman will ring IN before he begins, and ring OUT when the work is completed.

Workmen must not use a pencil to mark on this card.

All cards must be rung OUT daily before workmen leave factory, unless otherwise instructed by Supt.

W. S. ROGERS,
General Manager.

Back of Cost Card; Color, Red.

Job Ticket. Form No. 3.

COST CARD.

Factory Order, 763

Pieces, 2

Week beginning, SEP 18 1899

Correct: C Supt.

Work.	Day	In	Out	Parts
Annealing	A. M.			Axles
Assembling	M			Balls
Balling	P. M.			Bands
Boring	A. M.			Bearings
Broaching	T			Belting
Cleaning	P. M.			Boxes
Converting	A. M.			Cages
Cutting off	W			Cage Ends
Drilling	P. M.			Castings
Facing	A. M.			Collars
Filing	T			Furnace
Forging	P. M.			Light
Grooving	A. M.			Machines
Grinding	F			Material
Hardening	P. M.			Office
Inspecting	A. M.	9 24/25	11 35/39	Patterns
Laying out	S			Posts
Milling	P. M.			Races
Planing	A. M.			Rollers
Polishing	S			Shop
Repairing	P. M.			Sleeves
Riveting				Spools
Shipping				Stockroom
Slotting				Toolroom
Snagging	Hours, 2-13			Tools
Tapping	Rate, 20			Washers
Threading				
Turning	Cost, $.44			

Front of Cost Card; Color, Red.

Fig. 8

AT THE SHOP OF E. E. BARTLETT.

The attachment for a Brainard milling machine shown on the next page is a device in use at the shop of E. E. Bartlett, Boston, Mass., for increasing the capacity of the machine for milling the gear teeth of steel pinions. The pinions referred to are solid with the shaft and are those engaging with the racks of the plungers in the well-known Greenerd arbor press.

The number of these pinions to be cut yearly would scarcely warrant the purchase of an automatic gear cutter, yet the number of them is so great that doing them on an ordinary milling machine would mean tying the machine to one class of work and would also result in too high a cost price for this piece. By the rig shown, the capacity of the milling machine is said to have been multiplied by six. This results primarily from the fact that three pinions are operated on at the same time and also from the arrangement of the cutters beneath the work and the oil pan beneath the cutters so that they constantly dip into the lubricant as they revolve. By this scheme, the effectiveness of the cutters has been doubled over that possible when the cutters stand above the work in the ordinary manner. Perfect lubrication is obtained and all chips fall away from the work as fast as removed, thus preventing unnecessary work for the cutters.

The arrangement of the jig is quite clearly shown by the half-tone. It consists of a head- and foot-stock which are bolted directly to the milling machine table. The foot-stock has three arms overhanging the tail spindles, in the ends of which are setscrews with locking nuts. These are used to bear against the upper sides of the pinion shafts to prevent springing from the upward thrust of the cutters. The head-stock has three revolving spindles which are geared together so that they turn in harmony. The indexing mechanism is shown in Fig. 2. The two gears B B and the middle gear hidden by the index plate D, are all of the same pitch diameter and are meshed together as stated. Mounted on the same shaft with the middle gear are the index plate and the ratchet C and also the hand lever A, the latter being loosely fixed thereon. The index plate has twelve notches

for a twelve-tooth pinion and is locked for each tooth by the latch F. When the operator turns the pinions for a new indexing, he does it by raising the lever A until the pawl E engages with a tooth of the ratchet and then the downward movement turns the index plate through one division. When the lever A is raised, the latch F automatically raises from engagement with the notch, being actuated by a spring. The latch is again forced in engagement with the next notch by the action of the overhanging part of the lever A at G. By this simple arrangement, the indexing for the three pinions is done simultaneously and very quickly. The increased capacity of this milling machine is

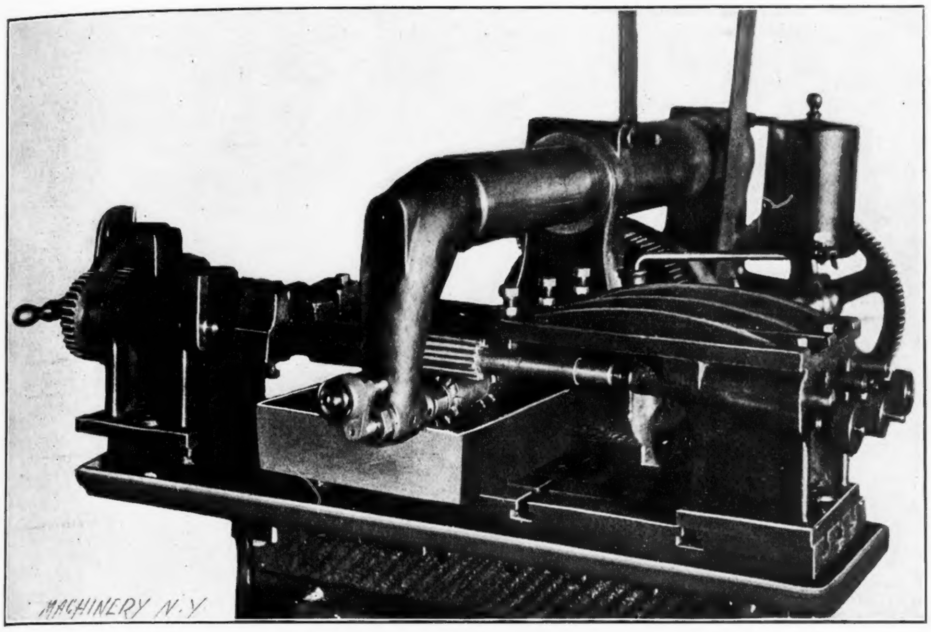


Fig. 1. Milling Machine Fixture.

such that the labor cost for the finished pinions is said to be very low.

On the larger arbor presses, the elevating screw for the work table works in a nut formed from the casting at the base. To ream out the cored hole and tap it is an awkward job. The way it is done is shown by Fig. 3 which shows an arbor press frame under an ordinary vertical drill and the reaming and tapping rig in place. The reaming and tapping rig consists of two blocks carrying the horizontal spindle, which are clamped to the frame of the arbor press. The spindle has a bevel gear splined on it and engaged with the gear is a bevel pinion driven by a shaft containing a pair of Vanderbeek's universal joints. By this arrangement, it is not necessary to get the heavy castings to any precise position as the flexible shaft allows considerable latitude of position. The hand-lever at the right is for the operator to

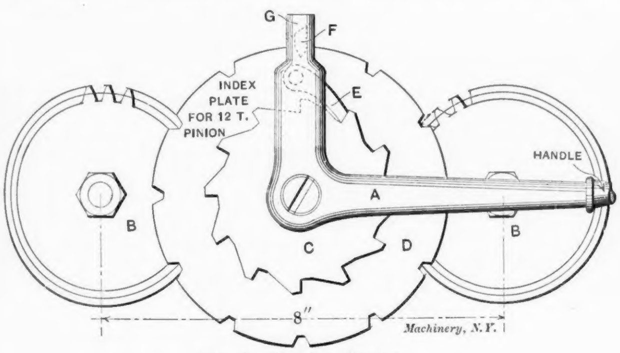


Fig. 2. Spacing Device.

feed the reamer through the work and also for starting the tap.

The vertical hole for the ram of the arbor press and the transverse hole for the pinion shaft are bored in a lathe specially fitted for the purpose, which enables both holes to be bored at the same setting, and thus insures their right angle position, a very necessary requirement. In the case of the largest press made, the No. 5 recently brought out, there are three transverse holes to be bored, one for the pinion engaging with the plunger rack and two for the shafts of the reducing gears. The hole for the ram is bored through a bushing with a three-lipped chucking drill in the lathe spindle and finished with a shell reamer driven in the same way and supported by a bushing of larger size.

The feature of the rig, however, is the method of boring the transverse holes shown in Fig. 4 on the next page. In place of the regular face plate of the lathe a spur gear 8¼" in diameter is fitted to the lathe spindle which thus drives the train of spur and bevel gears for transmitting motion to the transverse boring bar. The face-plate gear and the first two intermediate spur gears of the train are of the same diameter, the last large gear is 9", and the long pinion gear is 2⅜" in diameter. The train of gears and the boring spindle, together with the jig for accurately locating the holes, are mounted on a casting which is securely bolted to the carriage. Hardened steel bushings are provided for guiding the chucking drills and finishing reamers. Blocks are provided for raising the bar to the required height for the center hole. This, of course, raises the pinion gear, but the arrangement is such that the pinion gear is then as much above the center of the 9" gear as it was below it; so the center distance of the gears remains the same. When the spindle is moved over for the lower hole at the right, the pinion gear is, of course, merely moved along the face of the larger gear.

When boring the hole for the ram, the casting is supported on the carriage and a tail block, the two being tied together by the bar shown. When boring the transverse holes, the carriage is locked in position so that the face-plate gear is in the same vertical plane as the train supported on the carriage. The rig while primitive in the method of setting the transverse boring bar

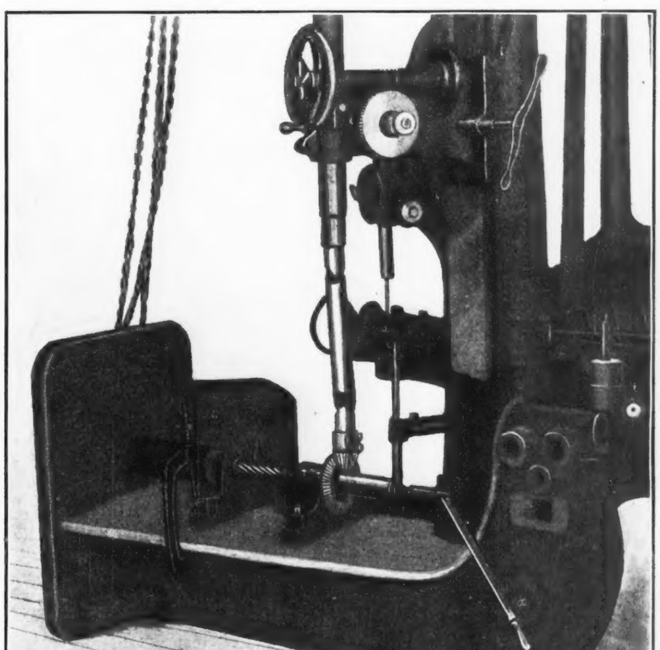


Fig. 3. Rig for Horizontal Drilling.

for the various holes in the case of the No. 5 press, insures accurate work and under the conditions prevailing where used, has probably proved to be as good as a great deal more expensive and elaborate arrangement.

A GERMAN LATHE SAFETY DEVICE.

A number of ingenious devices have been applied to engine lathes to prevent accidents from the feed rod and lead screw being engaged at the same time, but that employed by J. E. Reinecker, Chemnitz, Germany, seems to be about as simple and as effective as any. Fig. 1 illustrates the general appearance of the carriage of a lathe having the device is shown. The hand-wheel for moving the carriage is at the right and the handle for operating the split nut on the lead screw is at A. The one for engaging the feed is at B. It will be noticed that each handle carries on its spindle a half-disc, each having a reverse segment cut out of the periphery as shown more clearly at C and D in Figs. 2 and 3. In the position shown by Fig. 2, either the lead screw or the feed can be engaged, but if one is engaged, the other handle cannot be moved on account of being locked by the periphery of the other disc engaged in its corresponding recess as shown in Fig. 3. In Fig. 4 the construction of the apron mechanism is shown in detail. The halves of the split nut C C′ are operated from A by a pinion E engaged with vertical racks on each. The feed mechanism contains the familiar bevel gears for reversing the direction, the sleeve D carrying the reversing gears and being moved longitudinally by a short crank on the inner end of the shaft of B, engaged in the grooved sleeve at D′.

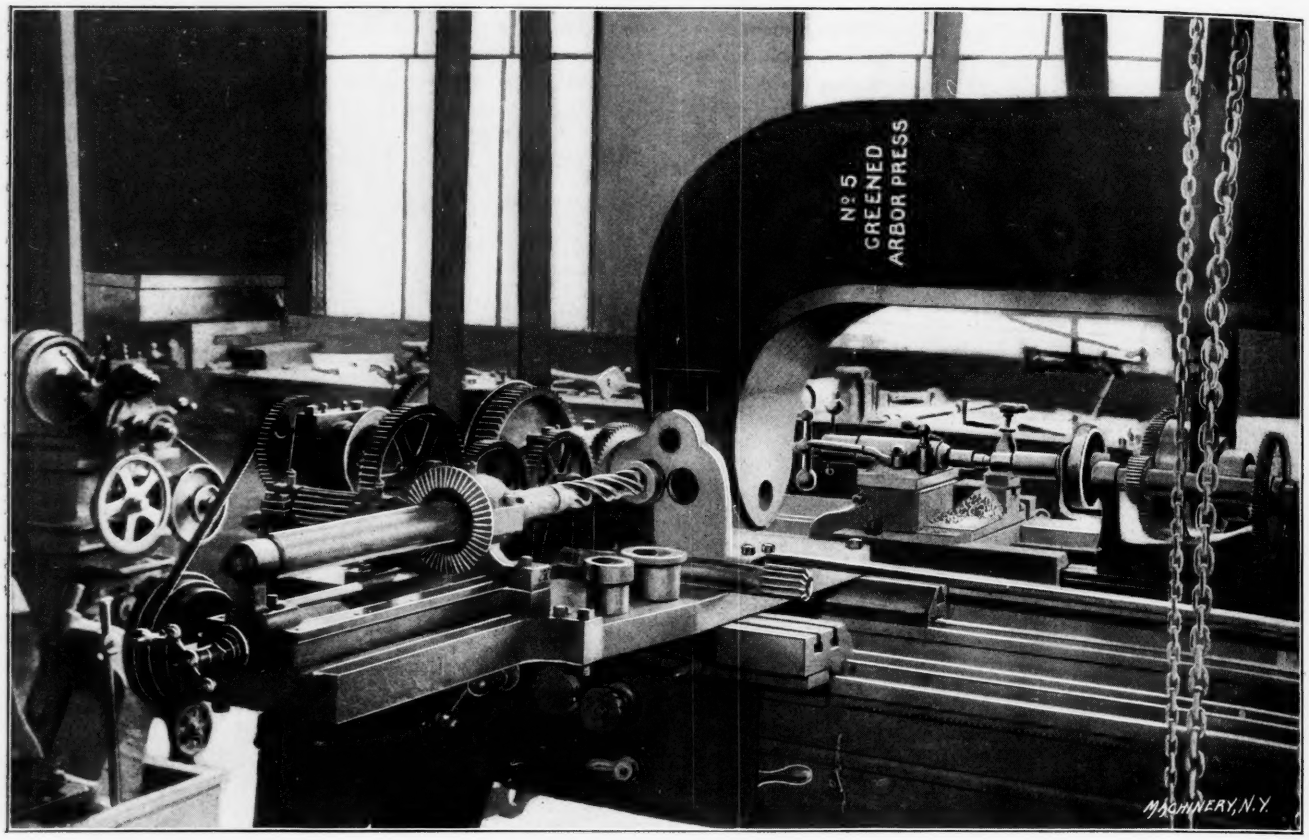


Fig. 4. Transverse Boring Rig for Engine Lathe.

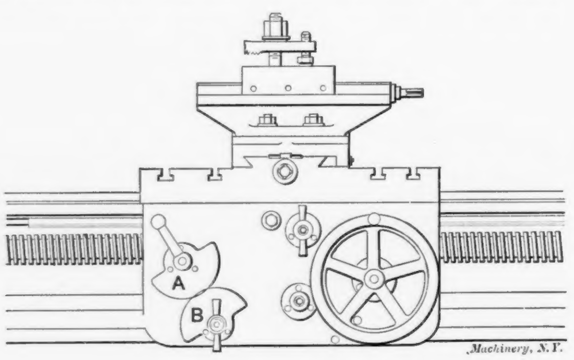


Fig. 1.

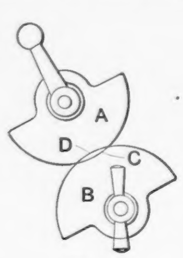


Fig. 2.

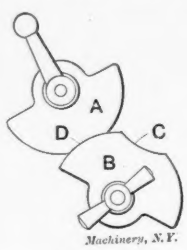


Fig. 3.

An American lathe maker using such a device would, undoubtedly, have concealed it behind the apron of the carriage where it would be equally as effective without in the least detracting from the appearance of the carriage.

The compound rest of this lathe is typical of European practice, and is of very substantial construction, though clumsy in appearance. It is apparent that the slide is well supported in any position of its travel, a feature sadly lacking in many American designs.

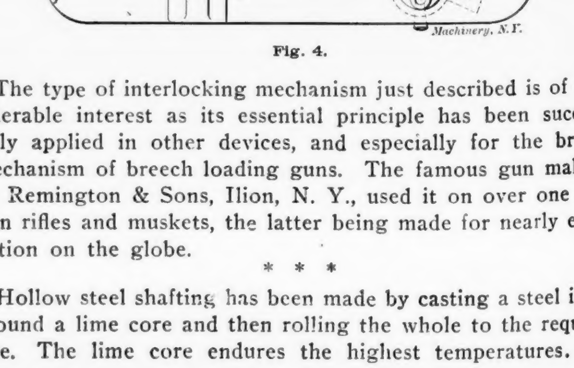


Fig. 4.

The type of interlocking mechanism just described is of considerable interest as its essential principle has been successfully applied in other devices, and especially for the breech mechanism of breech loading guns. The famous gun makers, E. Remington & Sons, Ilion, N. Y., used it on over one million rifles and muskets, the latter being made for nearly every nation on the globe.

* * *

Hollow steel shafting has been made by casting a steel ingot around a lime core and then rolling the whole to the required size. The lime core endures the highest temperatures.

BORING MACHINE.

DESIGNED FOR SPECIAL WORK IN AN ENGINE SHOP.

Through the courtesy of Houston, Stanwood & Gamble, steam engine builders, Cincinnati, O., we are able to show photographs of an interesting boring machine in use at their works. This machine was built by the Barrett Vise and Tool Co., Meadville, Pa., but has been so changed by additions and attachments to adapt it to a varied line of work, that it is virtually a home product.

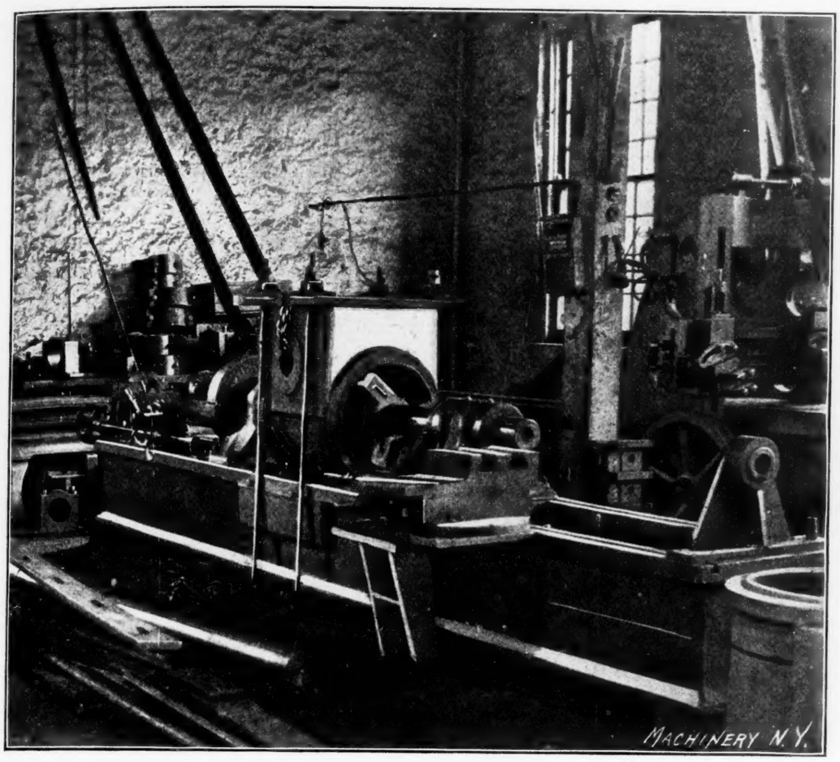


Fig. 1. Cylinder Boring.

The general features of the machine will be evident from Fig. 1. There is a deep horizontal bed, on one end of which is the driving head for the bar. The bar feeds longitudinally, carrying the cutter head with it, the feeding mechanism being located in the driving head, as is plainly shown in the engraving.

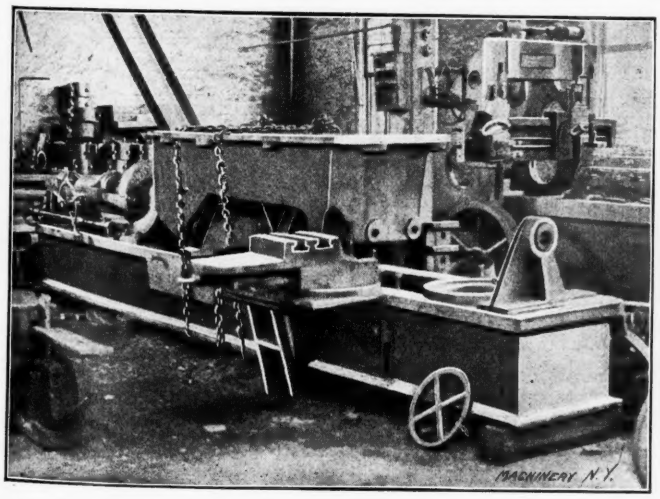


Fig. 2. Facing a Bed Plate.

In Fig. 1, a cylinder is in place on the bed of the machine, for boring and facing. When the size will permit, it is held by a special chuck secured to the top of the machine, the steam chest being down, and in this position it is machined. The larger cylinders are supported upon four large screws, the steam chest being up and they are secured in position by clamps. Besides being bored, the cylinders have their flanges turned on the periphery, both ends being made exactly the same diameter. After boring and facing, the cylinders are planed; "V" rests fit slots in the planer, and in these "V's" the cylinders lie, carried at each end by the turned flanges. This method of chucking is very easily done. The valve seat, face of the steam chest, and top and bottom pads for steam and exhaust flanges, are planed at one setting. Two cylinders are usually planed at once, being placed side by side on a large planer.

In Fig. 2, the machine is at work upon a bed plate. The engines built by this firm are of the plain slide-valve type, the beds having planed guides. The cylinders are bolted to the ends of the beds, and it is therefore necessary to face the ends of the bed plates. This is accomplished after planing the guides, by setting the bed plates upon special fixtures that locate the planed guides parallel with the boring bar. The facing arm is then brought into play and the bed plate is faced true with the guides, ensuring perfect alignment when the engine is running.

A third use to which this machine is put is illustrated in Fig. 3. This shows a crank shaft for a double engine erected on supports bolted to the bed of the boring machine. These supports bring the shaft parallel with the bar, and enable the holes for the crank pins to be bored after the cranks have been forced upon their shaft. In the August number of the paper the necessity for boring cranks after they are in position on their shaft was mentioned in a brief article describing a boring fixture in use at the Lane & Bodley Works, Cincinnati. The method shown in the accompanying illustration of the present article is of interest in that it shows another manner of accomplishing the same result.

In each of the engravings it will be noted that there is a bracket attached to the bed plate of the boring machine, which carries a large lathe slide rest. As there is no provision for feeding this slide rest longitudinally, and it is somewhat unusual to find such an attachment on a boring machine, where it could hardly be expected to be of any service, it may be wondered for what purpose it was designed. It is, however, only one of the many attachments that have made this machine perform a diversity of operations such as arise in an engine-building shop. It was desired to

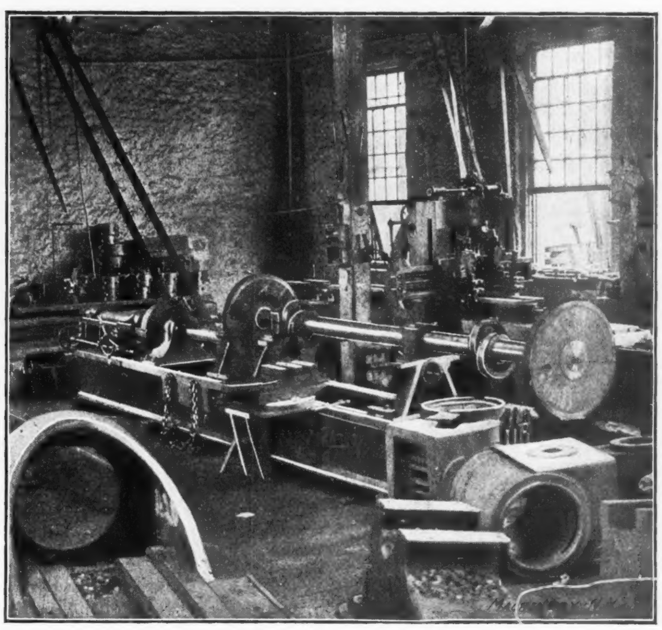


Fig. 3. Boring the Crank-pin Hole true with the Shaft.

cut off some unusually large stock, and a large cold saw was attached to the boring bar, while the stock was bolted to the slide rest. The stock was then fed against the saw, and the operation was performed successfully, and much easier than it could have been done in a lathe.

RICHARD ARKWRIGHT AND THE WATER FRAME.

W. Midgley.

Almost simultaneous with the invention of the "Jenny" was the successful introduction of the method of spinning by rollers comprised in the "Waterframe" of Arkwright.

The original idea of drawing by rollers is undoubtedly that of Louis Paul and his partner, John Hyatt, who, in 1738, obtained a patent for drawing cotton and making it into yarn by means of three pairs of rollers, driven at different speeds, which elongated the sliver to any extent. Though Paul failed to bring this invention to a commercial success, the idea was again revived in 1767 by Thos. Highs, of Leigh, in Lancashire, who, with the aid of Kay, a watchmaker, constructed an experimental machine of two spindles. Although this machine underwent a very successful trial, Highs never had the means to bring it into successful use, and it had to be abandoned. Such was the state of matters when the attention of Richard Arkwright was directed to the subject.

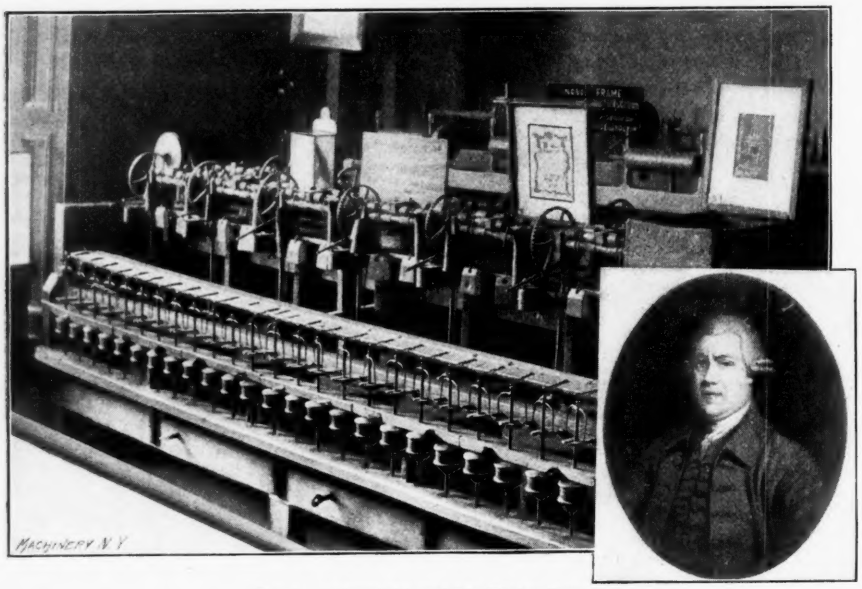


Fig. 1. Arkwright and his Water Frame.

Born at Preston, Lancashire, in 1732, Richard was the youngest of thirteen children. Being of a poor family he received only a scanty education, and was apprenticed at an early age to a barber. Whether he did not meet with success as a hairdresser in Preston is not known; at any rate, we find him in 1760 setting up business in Churchill, Bolton. Bolton was at that time a center of industry for spinning, weaving and bleaching. Hearing repeatedly from the conversation in his employer's shop of the greatly increasing demands for yarns, and being of an astute turn of mind, Arkwright began to inquire into the make of the spinning machine. He saw, as others did, that the fortune of the man who could improve upon it would be made. Nor was his appetite lessened when he fell in with Kay, at Leigh, who imparted to him much valuable information regarding High's machine. He immediately set himself to construct a machine on this principle, employing Kay to assist him in the work. The chief difficulty with which he had to contend was to twist the sliver into sufficient strength, and also to arrange suitable mechanism for enabling the attenuated yarn to be automatically guided on to the bobbin. The attenuation of the sliver was accomplished by an adaptation of the drawing rollers of Paul, and he successfully applied the principle of the distaf for twisting and winding the yarn upon a bobbin.

The machine when complete was exhibited at an election in Preston, but hearing murmurs outside the building, and remembering the fate of Kay, the inventor of the fly-shuttle, he packed up his model and removed to Nottingham. Here he obtained pecuniary assistance from Messrs. Stoutt and Need, who had entered into partnership with him. In 1769 he took out his first patent for spinning yarn by means of four pairs of rollers, but it was several years before any profits were made from the concern. A mill was first erected at Nottingham which was driven by horses, and afterwards a more extensive one at Cromford, Derbyshire, which was turned by water-power; hence the name of "Waterframe." About this time his life was one of continuous labor occasioned by organizing and conducting his numerous factories, erected in Manchester, Chorley and even in Scotland. In 1783 his partnership with Stoutt terminated and he retained the works at Cromford. From this time his concerns flourished wonderfully well, and he had the satisfaction of reaping the reward of his invention. He now rose to such esteem that in 1786 he was appointed High Sheriff of Derbyshire, and was shortly afterwards knighted. He did not long live to enjoy the honor, as he died in 1792, in his sixtieth year. Arkwright was a man of extraordinary genius and perseverance, with a keen business capacity, and he was undoubtedly the founder of the present factory system.

Both the "Jenny" and the "Waterframe" being introduced about the same time, there was more or less rivalry between the two. It soon, however, became apparent that Arkwright's continuous spinner, by putting the twist uniformly into the yarn, gave a rounder and stronger thread than was obtainable by the intermittent action of the Jenny, and therefore was more suitable for warp yarns, while Hargreave's machine produced weft.

The accompanying photograph represents one of the machines used in Arkwright's original mill at Cromford, and, as may be seen, is built almost entirely of wood. The construction of the frame displays great ingenuity on the part of the inventor. Though constructed more than 100 years ago, the "Waterframe" embodied all the principles of the modern "Throstle." It consisted of a creel suspended from the ceiling, in which the wings were placed side by side, and from which they were passed between three pairs of weighted rollers, Fig. 2. After leaving the front roller the yarn was conducted through a guide wire and wound on to a bobbin by means of the flyer D. Flyer D is fixed to the spindle, and, revolving with it, puts the required twist into the thread, whilst at the same time it winds the yarn delivered by the rollers on to the bobbin by reason of the latter dragging behind the spindles. In the distaf, the spindle revolved in one position and the yarn was guided on the

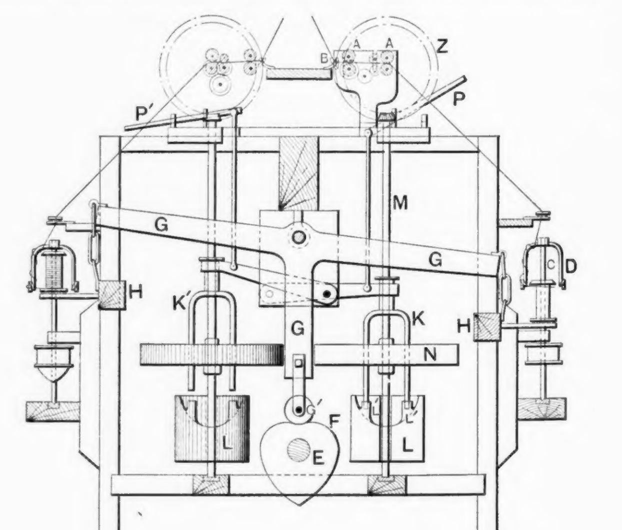


Fig. 2.

bobbin by means of hooks on the flyer. Thus as the bobbin filled at the bottom, the yarn was guided round the next hook, and so on until the bobbin was full. In the waterframe this was superseded by mechanical means, and here for the first time we have the automatic building motion. Running near the bottom of the frame is a wooden shaft E on which is fixed a cam F. As the shaft revolves the face of the cam moves the roll G′ of the T-lever G from side to side. Depending from either end of

the lever are blocks H, from which the metal supports for the bobbin project, and the latter thus receive a reciprocating motion, and wind the yarn in even layers up and down the entire length of the bobbin. It will be seen that the machine is divided into twelve independent sections, which are driven from a horizontal drum near the floor by means of a strap passing round a series of twelve pulleys L. Adjustable drums B Fig. 3 are used to afford better grip on the pulleys and also to take up any slackness of the strap.

The object of dividing the machine is at once apparent, as, upon the breakage of an end, only four spindles need be stopped for piecing instead of the entire 48 in the machine. The mechanism for effecting this is of a very simple character but at the same time very effective. It consists of the wooden drum L, in which are two iron pegs L', running loosely upon the upright shaft M. The drum can, however, transmit its motion to shaft M by means of a fork K, passing through the holes in the pulley N, keyed to the shaft. This pulley drives four spindles by means of a strap passing around pulleys on the latter. Fixed to the top of the shaft is a small pinion driving a large bevel Z on the front roller, so that they receive their motion from the same source as the spindles. On the breakage of an end the lever P is pulled down, as at P', and being connected, by the levers shown, to a spool on the fork K, the latter is lifted out of contact with the pegs and the shaft stopped.

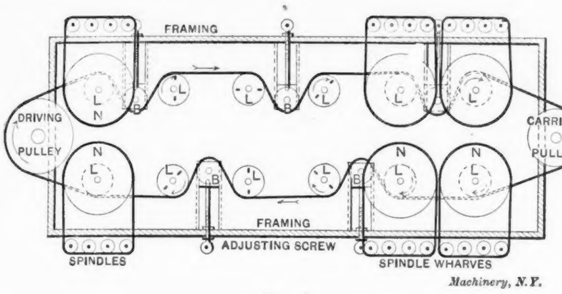


Fig. 3.

The method of driving the back rollers is very interesting. They are driven from the front by means of small spur wheels, made of brass, and a draft or attenuation of 3¼" is provided for. The bottom iron rollers are fluted and as seen to-day are in almost perfect condition; the front top roller is fluted, whilst the second and third are of wood covered with leather. The thread-board B carrying guide-wires B' receives a slight traverse from a cam to prevent channeling, as, even in these early days, it was recognized that the cotton would wear the rollers into ridges if allowed to run continually in one place.

Such is the mechanism of Arkwright's frame, which has come down to us with very slight modifications, and the value of the invention cannot be overestimated, as at the present day more than a million spindles are running on this principle, which give employment to thousands of work-people.

* * *

NOTES ON HARDENING STEEL

WITH SPECIAL REFERENCE TO MILLING CUTTERS.

BUCKEYE.

The hardening of steel in a machine shop is a thing that every man in the place is sure he can do better than his neighbor, as long as he is not obliged to do it regularly. This makes the position of chief hardener an unenviable one and one hard to fill satisfactorily for a long term. Even the writer is not free from some egotism on this subject and very often concludes that he could have made a success at it.

At the shop of the Cincinnati Milling Machine Co. we have for hardening miscellaneous tools a miscellaneous lot of fires for this work: A large oven heated by a coke fire, a small oven heated by gas, and a lead crucible heated in the same manner, besides three Bunsen burners with air blast. For forging and some hardening, a down-draft forge is provided. As our blacksmith has all kinds of forging to do we do not oblige him to do any hardening, but have another man who does it all.

For cooling, brine is mostly used, which we keep as cold as possible. The brine tank can also be used, if necessary, with a stream running out and a fresh one running in. We are using a "compound" to some extent at present which seems to give fair results, but more depends upon the fidelity and care of the man who does the heating, and the manner in which he puts the pieces into the water, than almost anything else, for having the pieces come out hard and free from cracks. Pieces with deep recesses will sometimes have to go toward the liquid with the recessed parts first and the remainder of the tool following and vice versa. A stream of water striking against the piece is sometimes an absolute necessity. Angle cutters had best be put in with the large diameter last. Some steels, we believe, are better taken out of the water immediately on the stopping of the vibration of the piece, and others will have to be left until perfectly cool.

The use of a compound for hardening steel is to be deprecated for several reasons. The first is that good steel, properly hardened in brine, will be so tough and hard as to sometimes, I have no doubt (although he may not acknowledge it) surprise even the man who made it. Second, if you want to hold a steel maker up to the mark on his steel, the first thing he complains of is the compound. Third, whenever a tool does not cut properly you blame it on the chemicals in the hardening compound, the effect of which you do not know, and when you do get a fine tool you give the compound the credit for it. The chances are you are not right in either case. But when a man comes around and talks "compound" and increased output you may sometimes be excused if you are "bitten."

We use all kinds of steel, both English and American, and have found some very good and some very poor of both kinds. A good piece of steel generally commands a good price. The writer thinks there is a steel made by Howe, Brown & Co., which is good enough for most machine shop purposes. Sometimes, but very seldom, when we are in doubt we give the steel maker the benefit of it and blame the hardeners. Cutters are very frequently broken and the breakage blamed onto the steel, etc., when the fact is, there is not enough space between the teeth or not enough lubricant being used to take care of the chips.

Another thing which breaks T-slot cutters, and is blamed to the man at the forge, is the new way of taking off one side of every other tooth to prevent breakage. This is all right to a limited extent, but is carried too far in the cutters on the market.

The gas furnace seems to be an excellent place for heating everything, as it can be heated to a nicety. We have to use considerable caution to get just the proper quantity of air or the pieces will scale and possibly not harden. For hardening small parts that need to be highly finished, pack in small boxes with bone dust.

The lead bath will hardly do for such a large variety of work (that is as we have it arranged) on account of the lower end of the long pieces getting too hot. Pieces with sharp projections are liable to break unless pretty well heated beforehand, and the heat watched very carefully before the piece is put into the water. Small pieces hardened on one end only are best hardened in lead. The lead is liable to get too hot before it is noticed and, taken all in all, it requires a more skilful man to use it.

In order to keep the lead from sticking, about an inch and a half more or less of charcoal must be kept burning on top of the lead, the object being to use up the oxygen of the air before it reaches the lead. Heating in lead is by far the most rapid way unless an automatic appliance can be fitted to a gas oven.

It has been impracticable to use our large coke furnace for hardening unless the pieces were packed, on account, we think, of the scale which is formed on the pieces. In preparing pieces for hardening they should be smooth. If lathe tool marks are left in the steel it is practically impossible to harden some steels nicely.

Our experience has indicated that what is needed most, is some way of telling readily without trusting to the man's judgment on each piece just when the temperature of the furnace is right.

The furnace should be placed in a darkened room or at least on the north side of the room where the sun's rays will not come anywhere near it and dark curtains should be hung up at any windows in the vicinity.

PATTERN MARKS IN CONNECTION WITH THE SHOP SYSTEM.

George H. Hall.

Pattern marks are intended primarily for the classification and handling of patterns. They are, however, capable of wider service in connection with the shop system of keeping track of work and in keeping costs. For accomplishing this, the pattern mark or number is cast on the piece in raised letters or figures, and a system of classifying the patterns is adopted, which gives to each mark a distinctive meaning. For example, all patterns marked L are lathe patterns; all those marked S are shaper patterns, and so on. Then 10 L means the pattern is for a 10" lathe; 30 S means it is for a 30" shaper, etc. Under these marks the patterns are numbered consecutively, so that a foreman who sees a pattern bearing the mark 26 D 17 knows at once that the piece is a part of a 26" drill and a reference to his production list of 26" drill shows him what the piece is, how many he is to make, and the number of the drawing on which it is shown. This production list is the working key to the whole system and should be prepared with great care and attention. Fig. 1 shows a sample page of a production list for a 20" lathe. It is preferable that the list be made on drawing paper so that blue-print copies may be made for use in the shop. One copy of this is prepared for use as a foundry order, and for this purpose is filled out only as far as the line A B. The remainder of the sheet may be removed, as it is of use only for the shop. A copy in full, as shown, is sent to the foreman, or if the work is to be done in more than one shop, a copy is sent to each foreman under whom the work will be done.

A

16

PUNCH FOR FILING

ORDER NO. 10375	PRODUCTION LIST	20" LATHE				
NO. PER MC.	NAME OF PIECE	PAT. NO.	NO. WANTED	MATERIAL	DRAWING	REMARKS
1	HEAD STOCK	20L1	25	CI	3475	
2	HEAD STOCK CAPS	20L2	50	CI	3475	
2	HALF BOXES (FRONT)	20L3	50	Bz	3896	
2	HALF BOXES (REAR)	20L4	50	Bz	3896	
1	BACK GEAR QUILL	20L5	25	CI	4578	
1	BACK GEAR (LARGE)	20L6	25	CI	4599	TO BE CUT BY B&S
1	BACK GEAR (SMALL)	20L7	25	CI	4573	" " " " " "
1	CONE	20L8	25	CI	2875	
1	CONE PLATE	20L9	25	CI	2876	
1	HEAD GEAR	20L10	25	CI	2694	TO BE CUT BY B&S
2	TAIL GEARS	20L11	50	CI	2695	" " " " " "
1	SPINDLE	20L101	25	MS	3476	
1	LOCK BOLT	20L102	25	MS	2876	DROP FORGING
1	LOCK BOLT NUT	20L103	25	MS	2876	MAKE FROM BAR

B

Fig. 1. Sample Page of Production List for 20-inch Lathe.

For the purpose of charging time and keeping costs, an order mark or lot number is issued with each separate lot of machines, and this together with the pattern or piece number, appears on the workman's time card (Sample time card), Fig. 2.

In order to keep this part of the system consistent, a piece number is given to all steel pieces or forgings, and for working purposes in the shop, this is treated the same as the pattern number. It is customary, in giving the piece numbers, to make some distinction from the pattern numbers; as, for example, having the pattern numbers begin at 1, while the piece numbers for the steel parts begin at 101.

For cost keeping, a sheet is issued for each piece which appears upon the list, or if it is not thought necessary to keep the cost of each piece separate, certain parts may be grouped on one sheet and the cost kept of certain sections of a machine. Thus, for the lathe, a separate sheet may be issued for each individual part, or sheets may be issued for each group of parts—as bed and legs; headstock, headstock caps, and boxes; tailstock, tailstock spindle, screw, and sleeve. In this case, all time charged to 20 L 1 and 20 L 2 would be put on cost sheet 20 L 1 and 2, all time charged to 20 L 11, 20 L 12, or 20 L 13, would be placed on sheet 20 L, 11, 12, 13. This provides a ready means of keeping costs with comparatively little trouble.

Another advantage is that where order numbers are issued for each part or group of parts of a machine, mistakes are, if not the general rule, yet of very frequent occurrence. The average machinist is not a bookkeeper, and when his work is all charged to arbitrary numbers, it is small wonder that he makes mistakes or bothers the life out of his foreman every time he makes out a time card. With this system, however, he soon learns the number of the lot of machines being constructed, and for the rest of his number he has only to look at the piece on which he is working, and there it is, cast in plain sight and affording no excuse for a mistake.

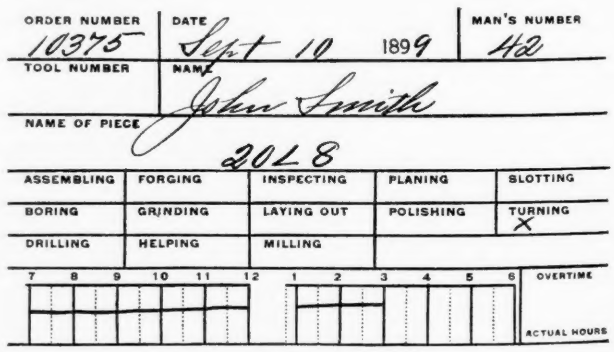


Fig. 2. Sample Time Card.

The foreman on his part is assisted by this system of marking in that the numbers afford a ready means of identifying castings whose appearance is new to him. The first part of the number, 20 L, for example, shows him that the casting is for use on a 20" lathe. The second part of the number, 23, is referred to his production list, which informs him that this piece is an intermediate gear, stud, bracket, and is shown on drawing 2,678.

To the outsider, this system of marking patterns is not without its advantages. Who that has had any experience with filling orders for repair parts does not know how a customer lies awake nights to think of a fitting name by which to describe the part he wishes to replace? And, in ninety-nine cases out of one hundred, a name will be hit upon that is wholly new and unknown to the builders of the machine. With the mark upon the piece, however, he need send only for a duplicate part bearing such a mark and there is no chance of any misunderstanding.

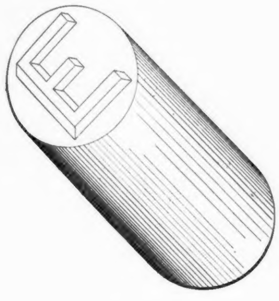


Fig. 3.

Fig. 4.

As to the numbers themselves, they should be of sufficient size and form to stand out clearly on a casting, and for this purpose what is known as the skeleton Gothic letter is the most suitable. Letters and figures $\frac{1}{4}''$ in height will give very good results if carefully moulded, but wherever practicable, $\frac{3}{8}''$ or larger should be used. These letters, made from type metal, can be obtained at a very small expense. They should be fastened to the pattern with thick shellac and a few small steel rivets. If an iron pattern is to be made, the letters can be fastened to the master pattern with shellac alone, but when a pattern is to be used many times, it is not best to depend solely upon the shellac. If it be desirable to put new marks onto an iron pattern, the letters should be cast on the end of small cylindrical stems, as shown in Fig. 3. Holes are drilled in the pattern and the stem is turned to a good driving fit and forced into the holes until the base of the letters are flush with the face of the pattern. This is a much more satisfactory way of marking iron patterns than trying to stick the letters on with glue or cement.

Some little care must be exercised in putting the marks on a pattern, as they must be placed where they will "draw" well, and at the same time, if possible, on a part of the casting that is not to be machined.

In some cases it is possible to retain the mark, even where the piece is machined all over, by countersinking a small portion of the casting and having the letters raised above the surface of the countersunk part, yet not high enough to be machined off. This is illustrated by the bushing shown in Fig. 4.

* * *

WOOD LAGGING FOR AN ELBOW.

I. McKim Chase.

In covering steam pipes with materials of low heat-conducting properties for the purpose of retaining heat that would otherwise be dissipated, it is necessary, especially on vessels, to cover the non-conducting material itself, and thus increase its durability while giving it an appropriate finish. For this outside covering black walnut lagging is largely employed.

In work of this kind peculiar shapes are frequently encountered which tax the skill and ingenuity of the workman in his effort to satisfactorily cover them. The most common are bends of pipes.

The illustration shows the different stages in constructing a right-angle bend for a pipe of wood lagging. On a suitable board, circles of the exterior and interior diameters of the bend are described, and from these the number of pieces or segments to compose the bend are determined. The illustration shows a bend composed of twelve pieces, six in each half.

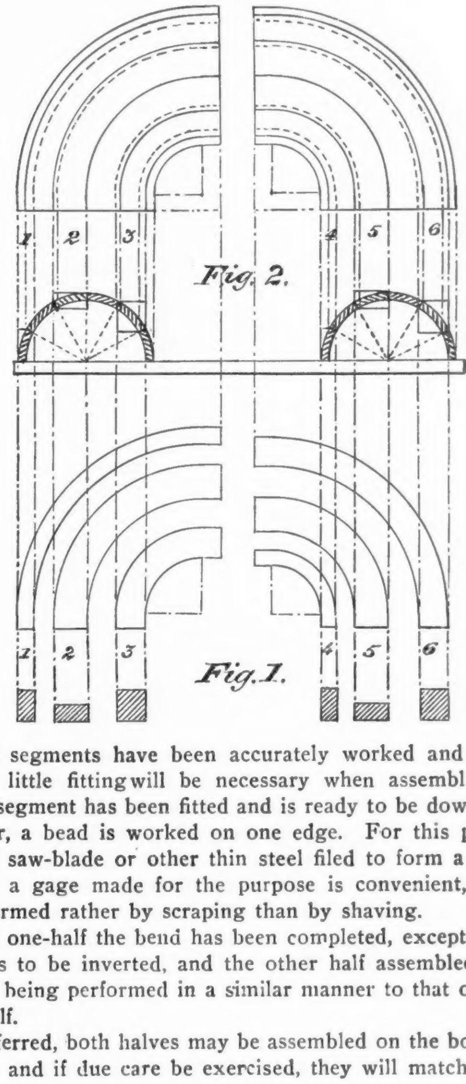
The material is first brought to the required thickness, according to the location of the several segments in the bend, as shown by 1, 2, 3, 4, 5, and 6, Fig. 2. These are all the pieces which compose one half the bend, 6 joining next to 1; 5 next to 2, and 4 next to 3. The different segments can be laid off directly on the material, but by the use of prepared templets, the material can often be worked to better advantage.

The illustration shows a plan and section of the different pieces and clearly shows the method of laying them off.

After the curvature of the pieces has been worked out, the next thing in order is to bevel the edges that the pieces may closely join when assembled. This bevel is required to be a radial line of the circles, Fig. 1. The thicker or outside segments are most conveniently beveled from the sides which are to be curved, and the thinner or inside pieces from the top or flat side.

The required thickness of the segments being gaged after beveling, they are worked to the exterior circle by templet. The insides are next worked out, which may be done roughly, as with these parts it is only necessary to approximate the circle.

When preparing to assemble the segments an outline of the bend is laid off on the board, and to this are secured semi-circular blocks of the inside diameter at each end of the bend. As the segments are assembled, they are made to fit these blocks, which serve at once as guides and supports. Pieces of pine block glued to the segments will be found convenient for securing them to the board upon which they rest. These blocks are easily removed when the bend is to be finished.



If the segments have been accurately worked and have not warped, little fitting will be necessary when assembling them. After a segment has been fitted and is ready to be doweled to its neighbor, a bead is worked on one edge. For this purpose, a piece of saw-blade or other thin steel filed to form a bead and fixed to a gage made for the purpose is convenient, the bead being formed rather by scraping than by shaving.

When one-half the bend has been completed, except to finishing, it is to be inverted, and the other half assembled upon it, this last being performed in a similar manner to that of the previous half.

If preferred, both halves may be assembled on the board, right and left, and if due care be exercised, they will match properly.

* * *

The car plant of the Pressed Steel Car Co., Pittsburg, Pa., is said to have a capacity of 100 cars a day and has frequently been run to its full capacity. The new type of cars are constructed entirely of steel, all the parts except the sheets that make up the sides, ends and flooring being forced directly into shape from uniform sheets of steel by hydraulic presses of great power. A standard wooden car, with a carrying capacity of 30 tons, weighs 30,000 pounds, and when loaded, the ratio of the load or paying freight to the total weight of car and cargo is 66.67 per cent. The pressed steel cars, with a carrying capacity of 50 tons, weigh only 34,000 pounds, and when loaded the ratio of the load to the total weight of car and cargo is 74.60 per cent. In the larger steel cars, those of 55 tons, for instance, the ratio of the load or paying freight to the weight of car and cargo is a trifle over 75 per cent.

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NOVEMBER, 1900.

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1899.		1900.		1900.	
December ..	18,500	April	21,500	August	21,500
1900		May	21,500	September ..	21,750
January	20,000	June	27,500	October	24,000
February ...	20,500	July	22,000	November ..	25,000
March	25,000				

A STEP TOWARD SMOKE ABATEMENT.

The beginning of what is destined to be a very important movement in the cities of the West, and later in the East, is the action recently taken at Cleveland, Ohio, toward the abatement of the smoke nuisance in that city. The business and manufacturing districts of Cleveland are so situated, relatively, that the smoke from the chimneys of the manufacturing plants at times sweeps through the business and residence sections and thus aggravates the nuisance of an atmosphere already laden with smoke particles.

There has been for several years an ordinance in Cleveland, for the suppression of smoke, but the machinery for enforcing it was entirely inadequate, and conviction in police court almost an impossibility. Last year a committee of the Municipal Association canvassed the subject thoroughly, and as a result of their efforts a bill was passed by the Legislature making the Cincinnati law applicable to Cleveland, and creating the local machinery for its enforcement. Under this law is organized the Department of Smoke Abatement. The supervising engineer is appointed by the Mayor for a term of five years, and he in turn appoints the three assistant engineers and clerk who form the office staff.

Last summer Prof. C. H. Benjamin, of the Case School of Applied Science, who is well known to our readers as a valued contributor, was appointed by the Mayor as supervising engineer. In this capacity he will be able to influence manufacturers, by argument, facts and figures, or by more strenuous measures, if necessary, to adopt such methods or appliances as are necessary to reduce the smoke coming from their chimneys. It is reasonable to expect that this action in Cleveland will be followed by similar efforts elsewhere as people gradually become educated to the fact that smoke from stationary plants can be almost entirely prevented by proper care and attention, even where soft coal is burned.

* * *

THE COMMERCIAL SIDE OF INVENTIONS.

Inventors often complain that it is a hard matter for them to obtain the recognition from the public to which they are entitled. They cite instances where inventions have been stolen by others, who eventually obtain credit for them, and they refer to cases where wealthy individuals or corporations have profited by the inventions of those less fortunately situated, through their wealth and influence. While this is only too true in many cases, the fact must be taken into account that it is not alone the mere invention of a device that is important or deserves the credit. The device must be made practical and it must be developed and brought before the public before it can be of any value to them. Thus it is that those who have the business sagacity, or the ability to transform the conception, as contained in the invention, into a practical working object, occasionally become more prominently connected with the invention than the originator, and in an entirely legitimate way.

Bessemer was not the originator of the pneumatic process of making steel that goes by his name, and that revolutionized the industries of the world. He was anticipated by Kelly of this country, and Bessemer's invention was made a success only through another invention of Mushet, of England. But Kelly did not appreciate the importance of his invention, and did not work out the practical features necessary for its success as did Bessemer. The latter's enterprise and ability made his invention successful where Kelly's was not. Elias Howe did not invent the first sewing machine; but he made the first practical sewing machine, and it was through his persistence and willingness to endure hardships leading almost to starvation, that he obtained the credit for the invention of the sewing machine. Ericsson did not invent the revolving turret used on his Monitor; but it was he who achieved success with the invention, through his indomitable will power and executive ability. Corliss did not invent the drop cut-off gear; but he first adapted it to an engine in such a way as to produce an economy in steam consumption that has been improved but comparatively little during the last fifty years. Otto was not the inventor of the gas-engine cycle that goes by his name. He, however, was the one whose arduous labors are responsible for the present important position taken by the gas engine to-day as a prime mover.

It is said that not one man in ten is qualified to conduct a business for himself. In the same way and for the same reasons not one inventor in ten has the necessary foresight, the technical knowledge, or the capacity for business that are required to properly develop his invention and make it a monument to his memory. The inventor is wise who can appreciate this fact and can so associate himself with those who have the qualities that he may lack, and who can appreciate the value of the inventor's work as well as their own. Apart from any unscrupulous stealing of inventions, which is never justifiable in any case, we think it must be admitted that oftentimes an inventor who does not do his share in making his invention of the greatest possible value to the public, is not entitled to any more, if as much, recognition as those who do.

* * *

For the first eight months of 1900 the exports of steel rails from the United States was 256,276 long tons against 247,504 long tons from Great Britain for the same time. This is the first time that the exports of steel rails from the United States have exceeded those from Great Britain.

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—13.

SETTING UP PLANER AND SHAPER WORK.

W. H. Van Dervoort.

The proper securing of work in the vise or on the shaper or planer table for planing operations is a most important step in the production of satisfactory work. As the variety of work assigned to these machines is great, the operator continually finds himself against a new problem requiring good judgment and care. In most cases much more skill is required in the setting up of the work than in the machining.

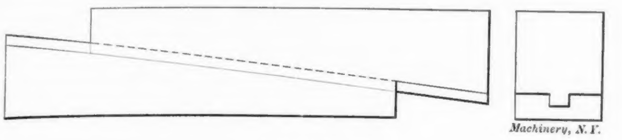

Fig. 116.

When the work is compact and heavy, and the amount of metal to be removed is relatively small, the danger of springing it is not usually great. If, however, the work is large, of irregular shape or light, the danger of springing is great. The springing is due to two causes: First, by un-uniform or severe clamping which distorts the work and throws the machined surfaces out when it is unclamped; second, the removal of the outer surface of a casting or forging, which frequently relieves shrinkage and forging strains and throws the work out of true. The first of these troubles can be overcome only by using the utmost care in setting up the work, and the second by, so far as possible, first roughing off all surfaces before taking any finishing cuts, thus allowing the work, after the roughing, to assume its normal condition as to strains.

The most important consideration in the clamping of work to the table is to locate the points of clamp pressure directly over the points of support. The supports should be firm and bear as equally as possible between the work and the table.

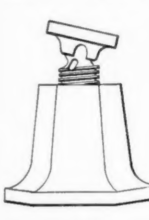

Fig. 117.

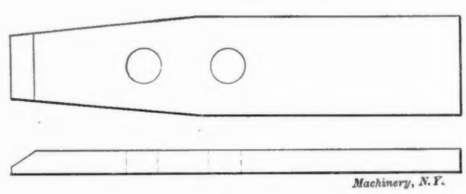

Fig. 118.

When only a thin shim is required to level up the work, it should preferably be of metal, as cardboard, leather or any compressible material will allow the clamp to spring the work. Good blocks and parallel bars are indispensable in the planer outfit. For work where the points of support vary in height, leveling wedges and small jack screws are most excellent, as they can be quickly adjusted to any desired height. These leveling wedges, especially if a single wedge is used, should be made with only a slight taper. In Fig. 116 is shown a pair of these wedges. When carefully made they form a good support and may be used to make the fine adjustment for height either directly on the work table or on top of other blocking. The planer jacks shown in Fig. 117 are most excellent, a few of these frequently replacing a large number of blocks of miscellaneous shapes and sizes. A good set of planer bolts should be found on each machine. Common machine bolts are not well suited to this purpose as the heads are too thick and not large enough to properly fill the T-slot. Planer bolts are preferably made of mild steel with heads turned to required thickness and milled on the four sides to properly fit the T-slot.* The clamp is usually made from a bar of flat steel with one or more holes drilled in it for the bolt, as shown in Fig. 118, and tapered somewhat on the work end to more readily enable it to be placed in the corners of the work. The clamp shown in Fig, 119 is made from square iron and forms a substantial and convenient form of clamp. Clamps of this character should be applied to the work in the manner shown in Fig. 120, as closely as possible; that is, the bolt should stand close to the edge of the work and the blocking for the outer end of the clamp as far away from the bolt as convenient, thus throwing most of the bolt pull upon the work and not upon the blocking, as would be the case if the bolt were nearer the blocking than the work. The T-slots should be sufficiently deep to prevent any reasonable bolt pull from breaking them out. This danger is, however, lessened by placing the work or its point of support as close up to the bolt as possible.

If the entire surface of the work is to be machined, clamps as above described cannot conveniently be used as it would necessitate changing their position during the cut, a most delicate operation with results usually unsatisfactory if a true surface is required. When the work has considerable thickness, small lugs or flanges can be cast on the edges for holding the clamp point and in some cases a drilled hole in the edge of the work can be made to receive the point of the clamp.

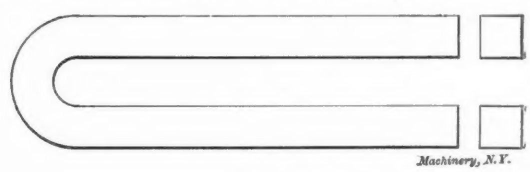

Fig. 119.

In cases where these methods are not convenient, the work can be held in the manner shown in Fig. 121. Two forms of post are shown in this figure, the one a plain pin to fit neatly in the round holes in the table and the other with rectangular base and tongue to fit the T-slots. A common set screw with cone point fits any of the tapped holes in the post, the height of these holes varying to suit the thickness of the work and length of finger used. The fingers are cupped to receive the point of the screw and the work end pointed to engage a prick-punch hole in the side of the work or preferably formed flat as shown in the figure. A suitable post to receive the end thrust of the tool must in all cases be set ahead of the work, and should be made of steel, preferably a low grade of tool steel, to insure stiffness, and turned to fit neatly the holes in the table. It should extend well into the hole, but should not reach high above the table, from two to four inches being ample. The shorter it is, the less liable it is to get bent. In Fig. 122 is shown such a post. The two holes drilled through

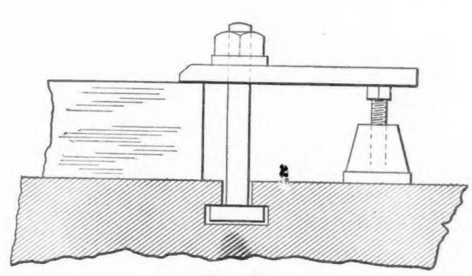

Fig. 120

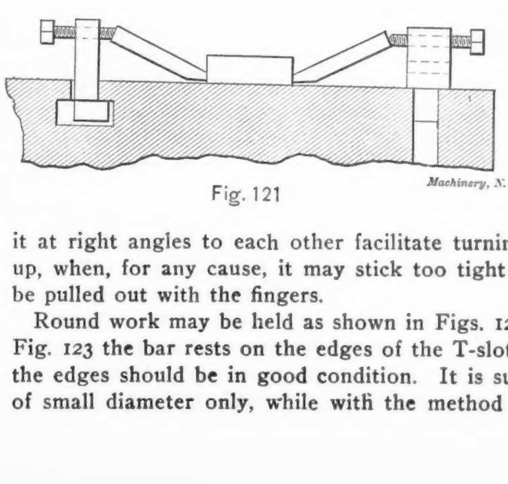

Fig. 121

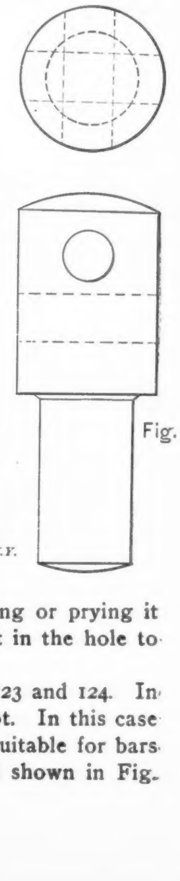

Fig. 122

it at right angles to each other facilitate turning or prying it up, when, for any cause, it may stick too tight in the hole to be pulled out with the fingers.

Round work may be held as shown in Figs. 123 and 124. In Fig. 123 the bar rests on the edges of the T-slot. In this case the edges should be in good condition. It is suitable for bars of small diameter only, while with the method shown in Fig.

* If the clamping bolts are provided with case-hardened nuts the life of the threads will be greatly lengthened and the nuts will also run easily, a very desirable condition.—Editor.

124 where a knee plate is used, a bar of any diameter can easily be held. A pair of V-blocks can be used very advantageously for holding round work. These blocks as shown in Fig. 125 should be tongued to fit the wards in the table and the V-notches planed with the blocks in place.

A good knee plate is frequently quite necessary in the securing of work on the planer table. The regular knee on the shaper, however, serves the purpose on that tool.

On long work the twisting deflection due to the weight of the work itself, must, where accuracy is required, be taken carefully into consideration. For example, long lathe and planer beds must in the machining be handled with great care Take a lathe bed that is to rest upon legs at each end. It should have the seats upon which the legs are bolted planed first, the points of supports being not at the extreme ends, but at points about one-fourth the bed's length from each end, with wedges so adjusted as not to twist the bed in its length. After planing the leg seats, the bed can be turned over and clamped directly on these seats, the bed assuming its natural deflection in which position the shears are planed.

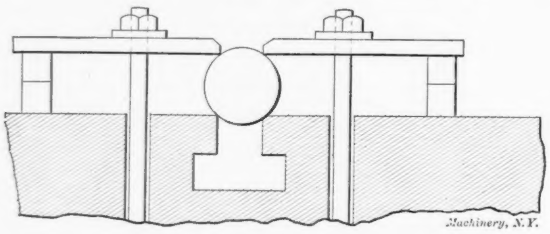

Fig. 123.

In securing work in the vise, the pressure of the jaw against the work should be as uniform along the surface gripped as possible. If the surface is somewhat irregular a soft packing as paper or leather will equalize the pressure. If there is much irregularity, however, it is preferable to cause the vise jaws to grip the work at points rather than throughout their entire length. For this purpose a wedge or solid block should be used between the work and jaw and located as near the ends of the jaws as possible. When a jaw is tightened onto the work its tendency is to lift, causing the work to lift on the movable jaw side. For this reason the movable jaw should be fitted nicely to its slide with bolts as previously shown in Fig. 113, for clamping it firmly after gripping against the work. Planer vise jaws are usually made of cast iron and a false facing of soft steel secured with bolts to these jaws is excellent when finished surfaces are to be gripped between them. It is important for nice work to keep the vise jaws in good condition.

Fig. 124.

The leveling and squaring up of work on the planer table is important. If the work has been laid out or some of its surfaces previously machined, the surface gage will be used in bringing these lines or surfaces parallel with the table. If a line on the work is to be set parallel with the line of motion of the table, the surface gage needle point will be adjusted to the line at one end with the base of the gage against the side of the slider. The table is then moved under the cross rail and the other end of the line brought to coincide with the point of the needle. Another method is to square up from lines that have previously been planed with a fine, sharp-pointed tool in the top surface of the table and with the caliper divider caliper from the blade of the square to each end of the line on the work, or if this line is not too far from the edge of the planer table the calipering may be from the line to a straight edge placed against the side of the work table. When the line on the work surface is to be set at right angles to the length of the bed, the work is brought close up to the cross rail and the line adjusted to the surface gage needle point with the base of the gage resting against the face of the cross rail or, as in the other case, the caliper dividers with a straight edge placed against the face of the cross rail can be used.

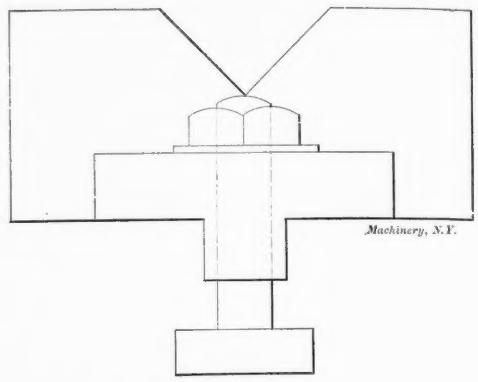

Fig. 125.

In the manipulation of the planer and shaper the beginner should keep a few points closely in mind. All planers and geared shapers do not have a fixed length of stroke, the depth of the cut and the speed of the countershaft affecting slightly the points at which reversals take place. Some allowance must therefore be made for the over-travel of the tool. An excessive amount of over-travel, however, means a large loss of time. Roughing cuts should be as heavy and at as coarse feeds as the machine will conveniently handle and the strength and character of the work permit. Before planing side surfaces see that the top of the tool box is inclosed from the work. Keep the cross rail clamped firmly to the housings when in use and parallel with the table. Before putting in the feed see that the feed gear is on the right spindle, as otherwise the tool may start up or down when it is intended to move across the work. As there are usually more ways than one to do every piece of work, study the way in which it can best be done. The manner in which the work is set up, the kind of tools used and the way in which they are ground, as well as the efficient handling of the machine all have an important bearing on the quality and amount of the work turned out.

* * *

THE IMMENSE KRUPP WORKS.

Advance sheets of one of the recent consular reports contain information about the Krupp Iron Works at Essen and give figures that impress one with the magnitude of the plant of this "king" of industry. Besides the coal and iron mines owned by the company, there are three ocean steamers engaged in their traffic and several works besides the immense plant at Essen.

The most important articles of manufacture of the cast-steel works at Essen are cannons (up to the end of 1899, 38,478 had been sold), projectiles, percussion caps, ammunition, etc.; gun barrels; armor plates and armor sheets for all protected parts of men-of-war, as also for fortifications; railroad material, material for shipbuilders, parts of machinery of all kinds, steel and iron plates, rollers, steel for tools and other purposes. The steel works in 1899 operated about 1,700 furnaces, forge fires, etc., 132 steam hammers, more than 30 hydraulic presses, 316 stationary steam boilers, 497 steam engines with an aggregate of 41,213 horse-power, and 558 cranes.

For the traffic of the works, railroad tracks of standard gage of about 36 miles are laid, which connect with the tracks of the main railroad station at Essen. Sixteen locomotives and 707 cars are operated on the grounds. In addition, there are narrow-gage tracks of 28 miles, with 26 locomotives and 1,209 cars.

The telegraph system of the steel works has 31 stations, with 58 Morse telegraphic instruments and 50 miles circuit. The telephone system has 328 stations, with 335 telephones and a circuit of 200 miles.

On April 1, 1900, the total number of persons employed in the different works was 46,679, viz., 27,462 at Essen, 3,475 at the Gruson works of Buckau, 3,450 at the Germania works at Berlin and Kiel, 6,164 in the coal mines, and 6,128 at the blast furnaces and on the testing grounds at Meppen, etc.

LETTERS UPON PRACTICAL SUBJECTS.

A MECHANICAL MOTION.

Editor MACHINERY:

The friction slip illustrated in the August number of MACHINERY was of especial interest to the writer, as it made use of a principle whose acquaintance he had made in devising a slip motion which should in some degree, overcome the heating difficulty.

Fig. 1 shows this motion. A is a sleeve driven constantly by the pulley on its outer end, and having clutch teeth formed on its inner end. B is a sleeve, which, with the central shaft to which it is pinned, has a slight endwise motion. This sleeve has clutch teeth formed on one end, and its body is a worm which engages with worm wheel C. The spring shown tends to keep the clutch in engagement. In the application of this device, D is a stop, engaging with a projection on a disc, keyed to the worm wheel.

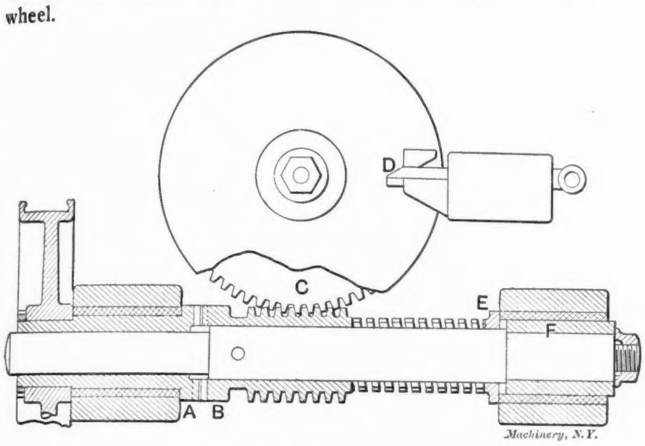

Fig. 1.

The apparatus is arranged, on the withdrawal of the stop, to allow the wheel to revolve once, and then stop. Starting with the parts in the position shown, on the withdrawal of the stop, the spring carries clutch and worm B—and with it the worm wheel—until it is engaged with the constantly revolving clutch A. The worm continues to turn its wheel, until the lug strikes the stop, or until some unforeseen resistance too great to be overcome by the spring is met with, when, the wheel being stopped, it forms a nut for the worm. This, as it revolves, screws itself out of engagement with clutch A. The strength of the spring is proportioned to the safe load.

slight endwise motion, is keyed the disc H, whose circumference is turned tapering to fit a corresponding taper in the hub of gear G. The motion is applied to this gear, and is transmitted by worm J to a worm wheel (not shown), for any desired purpose. Shaft I turns freely in the hub of gear G, and is pinned to worm J. Lever K, with its spring attached, suppplies the necessary amount of thrust, varied at will by the thumb screw and sliding block.

Gear G may run at any suitable speed, but the worm will not turn any faster than is needed to give the amount of pressure for which the spring is set; for, if it does, worm J uses the wheel for a nut, and climbs up until disc H is out of contact with the gear, when its motion stops.

The usual method of supplying a moderate, even, steady pressure, would be by weight, but difficulties increase with the force and travel required. By running gear G at a comparatively high speed and reducing the velocity by suitable gearing, the small spring may be made to furnish an accurately measured pressure of many times its own strength.

I hope that this scheme may prove practicable and useful.

Pawtucket, R. I. R. E. FLANDERS.

* * *

SELLING MACHINE TOOLS.

Editor MACHINERY:

It is a notorious fact that the most money is made by the man who sells the machine while the fellow who plans the little devices for getting them out cheap, shakes hands with himself if he gets his $2.50 per. Of course there's a reason for this—as for all things—and it's simply the old, old story of supply and demand. The chaps who can sell tools are not as plentiful as the men who can make them, and for the same reasons that a railroad president gets more than a track walker, the seller gets more money. But I'm beginning to think there may be a show for some of us machinists yet, judging by a chunk of experience I ran up against the other day and I'm going to cultivate my bump of sell-a-tive-ness to beat the cornet.

I saw a peculiar design of tool in a store window and went in to ask a few questions, as all good Yankees are bound to do. The first chap I struck wasn't a mechanic by a long ways, but he was honest and said so and turned me over to the head talker who was supposed to know what's what about machinery. The machine in question had two gears of exactly the same size between the driving pulley and the cutter and, as

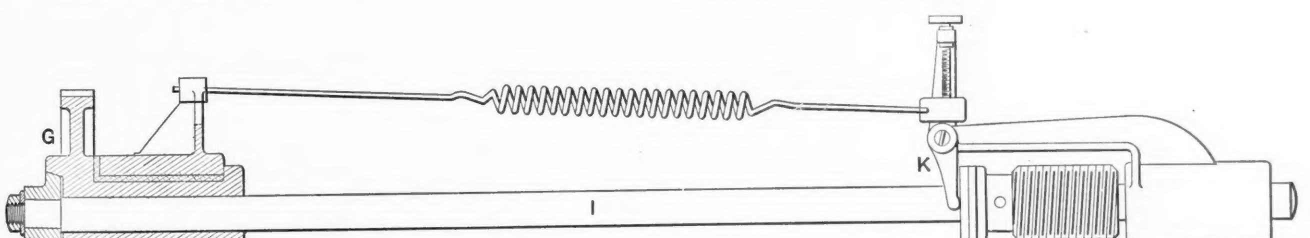

Fig. 2.

This arrangement has some advantages over the friction plates used for this purpose. Whether at rest or in motion, the amount of friction is limited to that due to the mere turning of the parts in their bearings; when out of engagement, the pressure of the spring is upon parts not revolving; when in engagement, between sleeves B and E, which are both keyed to the same shaft and revolve together. The motion is positive until undue strain is met with; the strength of the spring is accurately adjusted to the safe load, and once set need not be touched under all ordinary conditions of wear. The spring may easily be made adjustable. It might be necessary to add a small flywheel to carry, by its inertia, the clutches well beyond clicking distance.

Fig. 2 shows the principle arranged to give constant steady pressure of any desired degree, to any machine part—perhaps, under some conditions to a feed. To the shaft I, which has a

there was no change of speed, I couldn't see why this was done—but the head seller told me in one magic word—power.

"You see those are heavy gears on heavy shafts and they won't break, so you get a much more powerful machine than you would without them." I looked incredulous, I suppose—didn't intend to, as I wanted him to display some more of his knowledge (?) of mechanics.

"Don't believe it, eh! Well, do you suppose the designers of B. R. & X. Machine Company would put them in if they weren't good for anything? Don't seem to believe you gain power when you use heavy gears, eh? rather use light ones, I suppose," and he indulged in some more of his alleged sarcasm at the expense of your humble servant.

When the air cleared so I could see him, I only remarked that, in spite of the reputation of the world-famed company,

I didn't believe that gearing with even gears—even if they were heavy—added to the power of the machine for a cent and unless there was some other excuse for the design, it was not anything to be proud of.

Now, if these chaps who gain power by even gears can sell machinery, why can't some of us chaps who know better than to try and crowd such a yarn down a customer's throat, sell more tools than the other chaps do? I'm going to try it the first chance I get, and see how it comes out. Seems to me a man who knows enough to buy tools properly ought to appreciate a salesman who knew a little more about tools than the price.

I. Podunk.

* * *

A COMBINATION DIE AND A PIERCING DIE.

Editor Machinery:

The dies shown and described herewith were made for producing a cover of the shape illustrated by Fig. 2. They were made in two operations. An annular rib was drawn around the top at Q Q and six holes were pierced, equally spaced on a circle concentric with the center, and a large one in the center. The blanking and drawing of the cover as well as the

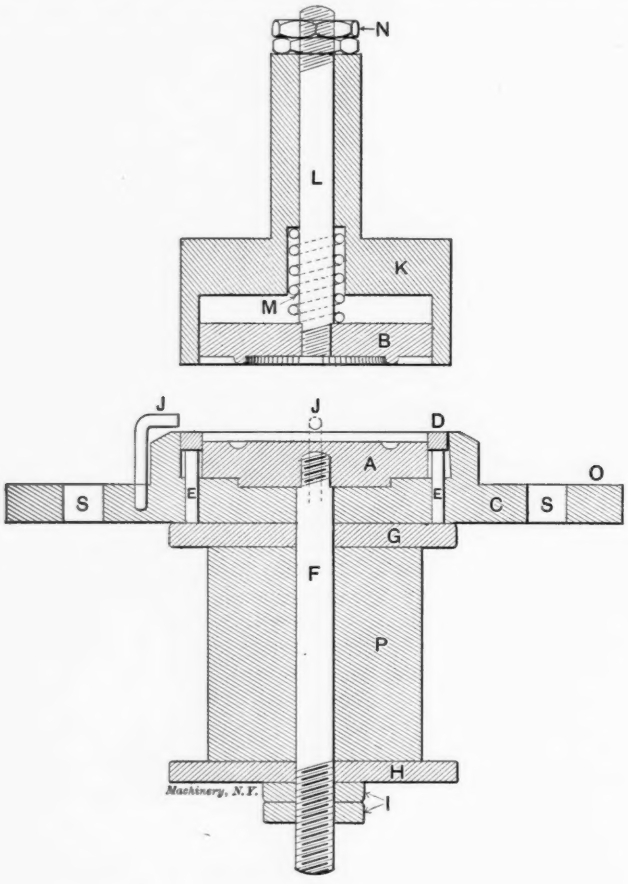

Fig. 1.

forming of the rib, were all done in one operation by means of the combination drawing and blanking die shown in cross-section in Fig. 1.

First a pair of gages were made similar to those shown in Fig. 3, the upper one O being the exact size of the cover and the lower one P the size of the inside, or two thicknesses of metal less. For the part of the gage designed for the rib the sizes were reversed, the radius of the rib of the bottom, P, being greater by one thickness of metal than the upper one. Great care and accuracy were exercised in the making of these gages. Now came the forming punch and die B and A, which were made of tool steel and had the shape of the gages worked out on the face of each. These were all finished to the exact diameter on the bottom of the forming die A. A shoulder was left for locating it central on the blanking die and a hole was then drilled and tapped in the center of A and B for studs F and E respectively. The faces of A and B having been highly polished, all marks and scratches being removed, they were carefully hardened and when tempered were just warmed, which left them very hard. Next the size of the blanking die was figured out and a template made, then the blanking die was made, which consisted of a machine-steel forging with a steel ring welded on for the die. Being faced off on the back it was swung in the lathe and a cut was taken all over the outside, and then it was bored and finished to the diameter of .010 less than the blank and bored deep enough to allow the top of the forming die to rest $\frac{1}{8}$" below the cutting edge, which tapered inward one degree.

The die was now hardened and drawn to a light straw color, set true on the face plate and ground to the exact size of the template. The blank holder ring D was then made to fit freely around the forming die A and within the blanking die O, which was also hardened and the upper face ground true. Six holes equally spaced were drilled in the base of O for the spring barrel studs E E. These were then cut off and finished exactly to size in order to hold the blank tight between the

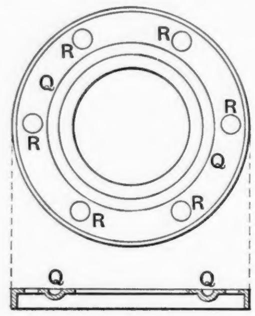

Fig. 2.

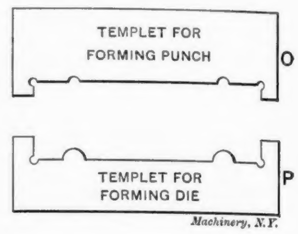

Fig. 3.

punch and blank holder while drawing. Two cast-iron washers G and H were then faced off each side and bored to fit the stud F freely. This stud was threaded at both ends as shown, with a shoulder on one end, and was screwed into the forming die A and let through the base of O. Then the washer G was slipped on, the spring barrel P (of stiff rubber) put in place, the washer H placed beneath it and the jam nuts I screwed up tightly. The studs E E were then let in, the blank holder placed in position and the die was finished, the hole S at either end being for fastening to the press bolster.

The blanking punch K, of tool steel, was machined to the shape shown in the illustration, with a hole through the center for the stud L, and was turned on the outside and bored inside for the forming punch B, .010 being left for grinding.

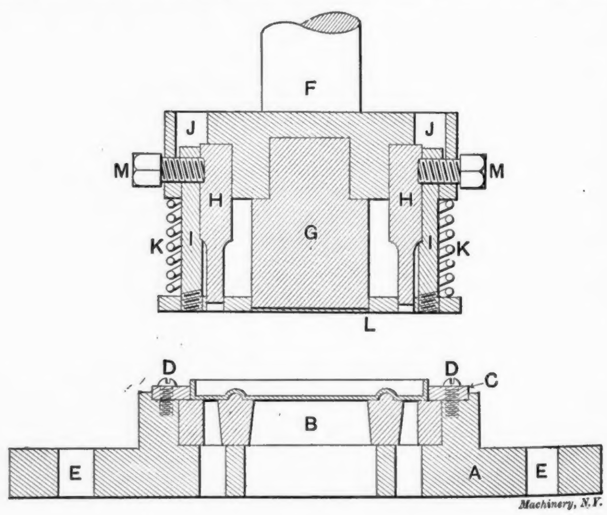

Fig. 4

After being counterbored back for the spiral spring M, and hardened and drawn to a blue temper, it was ground outside to just fit the blanking die and inside so that the forming punch B made a nice fit within. Now the stud L, the jam nuts N and the spring M were made and assembled as shown and ready for work. The pins J, of which there were three, acted as stripper and stop pins when operating. The metal was blanked and held between the face of the punch K and the blank holder D, with sufficient tension to keep it from crimping while being formed and drawn up into the punch. The spiral spring M expelled the finished piece from the punch.

The die shown in Fig 4 was for piercing the six holes R and

the large one in the center as shown in Fig. 2. The die B made of tool steel with a hole bored through the center was set upon the dividing head of the miller and the six holes were indexed, centered and drilled. It was hardened and drawn and the holes ground to size. The bolster A was bored to admit the die B with clearance holes in the base, two holes E E being drilled in the ends and one bored at the top to admit the gage plate C. This was fastened to the die B and within A with six round head screws D D, the face of B was ground, the various parts were assembled and the die was complete.

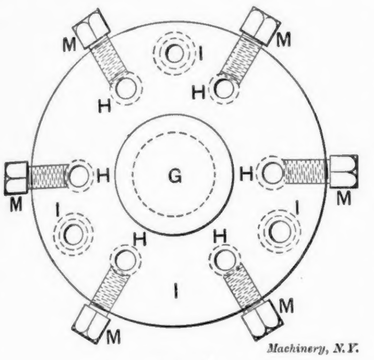

Fig. 5.

The punch consisted of a cast-iron holder F turned and finished, and of the hardened and ground punch G, which was let into a hole in the center shouldering against the face, as shown. The holes for the six small punches H H were transferred through the die B to the face of the holder F and drilled and reamed to size and the punches being hardened and ground were let in, being held by the set screws M, Fig. 5.

Now came the stripper plate L, for stripping the work from the punches, which fitted over them freely. See Figs. 4 and 5. Three studs I I I, with heads 3-16" larger in diameter than the body were screwed into the plate L; three holes J J J were drilled in F to allow them to move up and down freely, and were counterbored half way down to allow the heads I I I to shoulder and to keep the plate L when even with the face of the punches. The three spiral springs K K K were slipped over the studs I and the tools were then set up in the press. The work was now placed within the gage plate C, the punch descending, the large punch G blanking the center hole and entering the die first, then continuing down. The small holes were pierced and when rising the work was stripped from the punches by the plate L and the springs K K K.

Brooklyn, N. Y. JOSEPH VINCENT.

* * *

TROUBLE WITH TAPS.

Editor MACHINERY:

Some time ago we had a lot of trouble in our shop with some new hand taps. They were bought from a well-known firm of tap and die makers who had furnished us a similar order which had been satisfactory. Not so with these. The first man, who took a set, returned them in a few minutes, saying: "Give me them old taps; these ain't worth Hades room." The toolroom attendant looked at him with cold, silent scorn and handed out the old taps without comment. Words in his estimation would have been wasted on such a case.

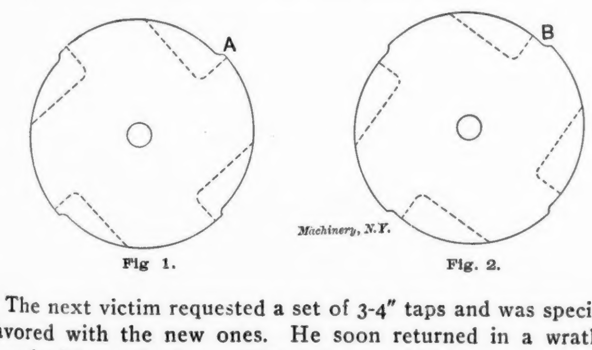

Fig 1. Fig. 2.

The next victim requested a set of 3-4" taps and was specially favored with the new ones. He soon returned in a wrathful mood with one broken. "What do you think I am; a jackass? It needs the strength of one to screw them taps in."

So it went. No one could use the new taps with satisfactory results. They would squeak and bind so that some of the old-timers were reminded of their apprentice days when unrelieved taps were common, only these "seemed just a leetle mite wuss."

Our toolmaker examined them carefully, but, not being much of an expert on taps, could not tell what was the matter. last complaint was made to the makers and the taps returned for examination.

It was found that the cutting edge of the teeth was somewhat lower than at a short distance back of it so that each tooth acted like a wedge. The explanation made was that some time previously they had a lot of taps ruined by a careless boy fluting them without reference to the position of the relieving, and that these had probably been taken to the stock room before the error was discovered.

In Fig. 1, the flutes are indicated by the dotted lines, as being cut in the tap, with the radial lines just back of the apexes of the teeth produced by the relieving machines as at A, which, of course, is correct. On these taps, however, the boy doing the fluting allowed his fixture for holding the taps by the squared end to be deranged so that the taps were not properly indexed relative to the apexes. This resulted in their being fluted somewhat as indicated at B in Fig. 2. The leading edge was thus lower than the portion immediately back of it, which made the teeth bind worse than if they had not been relieved at all.

Although the taps of Blank & Co. had always given satisfaction before, the disrepute following the experience alluded to will probably make them without honor in this shop for a long time. Small mistakes often lead to serious consequences.

Cincinnati, O. HOOSIER.

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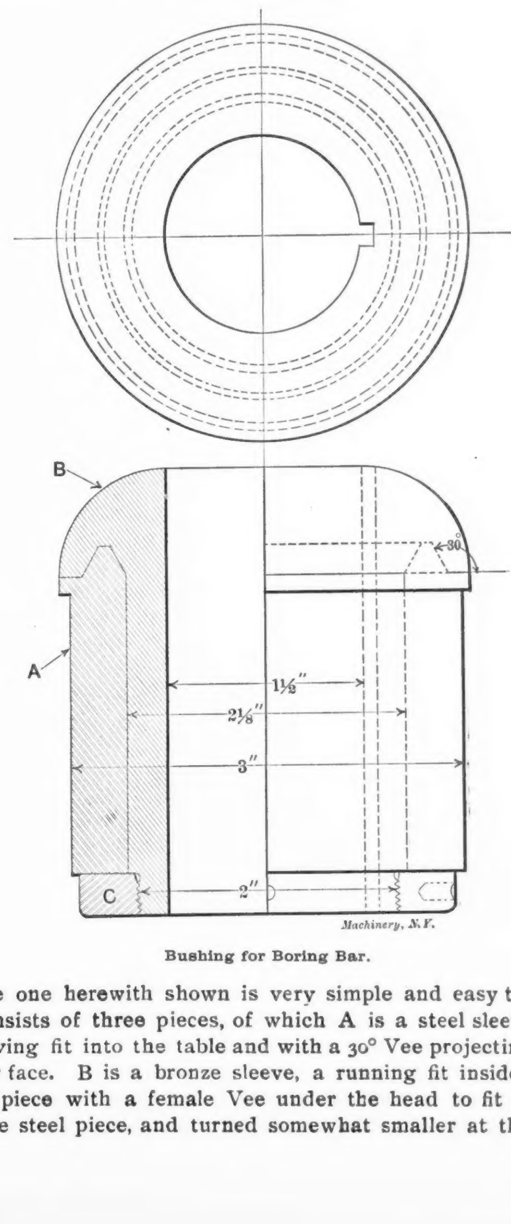
BUSHING FOR BORING BAR.

Editor MACHINERY:

Enclosed find blueprint of a bushing that I have never seen illustrated in your journal. I think it may be of interest to some mechanics who, when compelled to convert an upright drill into a boring machine, find it very annoying on account of the bushing in the table being loose for the bar.



Bushing for Boring Bar.

The one herewith shown is very simple and easy to make. It consists of three pieces, of which A is a steel sleeve made a driving fit into the table and with a 30° Vee projecting on its upper face. B is a bronze sleeve, a running fit inside of the steel piece with a female Vee under the head to fit the one on the steel piece, and turned somewhat smaller at the other

end and threaded for a steel nut C, which is screwed hard up to the shoulder of the bronze piece to make a running fit between the nut and the Vees on the other end.

The object of this combination is to reduce the wear of a plain bushing caused by the circular motion of the bar, together wih the grit and chips which have no other outlet than to force themselves down through the bushing, the result being that, in a very short time, the bar is too loose a fit to do a good job.

The bronze piece is splined to fit a key fastened in the bar which is a sliding fit in the bronze sleeve.

With this arrangement the wear due to the circular motion of the bar is transferred to the steel sleeve with its protected Vees. This necessitates an up-hill climb for the grit and chips in order to affect the vital parts of the bushing. The result is that it will, if nicely made, out-wear a great many plain bushings before the grit can commence its up-hill climb.

Providence, R. I. N. J. H.

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AN EXPERIENCE WITH CHECKING SYSTEMS.

Editor MACHINERY:

A few years ago your humble servant had the pleasure of working as a machinist in the locomotive repair shops of the Cascade Creek Railway Company, and while there he had quite an amusing, although at times exasperating, experience with various checking systems. On first going there to work, a number of the men were observed to be very considerate of their health. They had found out that it disagreed with them to rise early in the morning, so were in the habit of "appearing" between 8 and 9 A. M. They never seemed to arrive but just appeared on the scene of action in a very quiet and unostentatious way. Sort of a presto change effect as it were.

This condition of affairs continued for some time until the Old Man began to "get on to things," and investigate accordingly. As a result, he issued a general prescription which in effect was that all employees who valued their health, and incidentally their jobs, should be on hand promptly at the blowing of the big chime whistle in the morning. From personal experience he had discovered that early rising and moderate exercise were conducive to general health, all theories to the contrary notwithstanding.

To be sure that all took their medicine as prescribed, a clerk was detailed to stand near the main entrance of the shop yard to check each arrival, marking a straight vertical line for those on time and a cross opposite the names of any who were absent at the blowing of the whistle. The Old Man's medicine and the manner of administering it were promptly condemned, for, although licensed to prescribe by the Great B. R. G., he was not regarded as being qualified as a regular practitioner since he had stepped from the cab to his present job and surely could not diagnose machine shop symptoms.

Nevertheless the medicine had to be taken and, although highly disagreeable at first to the opponents of early rising, it was finally allowed not to be so bad after all, for is there not more than one hole in a skimmer? The Old Man had proceeded in his diagnosis on the theory that one prescription would last for all day, but in this he erred. If Jones wanted to go up town at noon to pay his dog tax and forgot to get back before two o'clock, there was no one to jog his memory. What was the foreman doing, do you say? Well, he had troubles of his own, and looking out to see if the men arrived on time was something that was not allowed to be added to his burden. The inevitable result was that the Old Man had to double his dose, and the clerk was detailed to guard the gate not only in the morning but at one o'clock as well. This seemed to be more than suffering humanity could stand, so a respite of three minutes after whistle blowing was ordered for the benefit of those whose digestion was being injured by too rapid injection of breakfast and dinner. It was found, however, that those nearest to the shops were those who always absorbed the extra three minutes, while those located at a considerable distance seemed always to be on time. The dictum then went forth that thereafter no grace would be allowed, but that all must be on time to the second. To help them in their strenuous efforts, a warning whistle was blown at five minutes of the hour and another at the usual time.

About this time the checking clerk conceived the brilliant idea that making straight lines and cross marks was an unnecessary labor. Why not have the men walk through a narrow passage way and each take his check from its hook on a large board, and a little further down the line, deposit it in a locked box? Grand idea, and forthwith adopted. Result the first morning—a mob looking in vain for checks and the last man in the line at his work at 7.20.

A modification of the brass check scheme was then tried, in which each one called his number at a window and received his check to be deposited in the little box aforesaid. This system continued with indifferent success for some time, but was finally abandoned for the old one in which each called his number to the checking clerk who responded by repeating it and marking the line opposite the name as before. One feature of the system not much appreciated by the men, was that the clerk on cold mornings sometimes forgot to come to discharge his duties. Being the son of Somebody, the omission to appear did not necessarily mean that his name should be dropped from the payroll. After waiting till the last whistle blew, the long grumbling line would break in wild haste for the sheltering shops.

One day a smooth salesman appeared on the scene with a time-clock arrangement. For each man a key was provided, having a tongue on which was his number. By inserting and turning this key in the machine, the number was printed on a moving strip of paper opposite numbers denoting the exact time. It was set up in one department for trial, but the president of the road happened to come around shortly afterwards and after a cursory inspection declared that the Cascade shops were no penitentiary and he was not going to have any such machine as that to keep tabs on the men.

These experiments had extended over a number of years. During this time the old general foreman had been invited to look to other pastures for the necessary wherewithal, while a new man who was more in touch with modern ideas took his place. The different checking systems did not please him because while in appearance they effected that for which they were designed, he knew that more or less fraudulent action occurred. Disputes between the checking clerk and the men were frequent and were referred to him for final discussion. At last he had his little say, and as a result, the whole checking system, as it had been practised, was abandoned.

In place of it, the under-foremen were required to certify to the time cards of the men under them. Each man was expected to be on time as promptly as before, but if by reason of some little slip, he arrived ten seconds late, it was excused provided the occurrence did not become chronic. The result was eminenly satisfactory not only to the men but to the railway officials as well. The system had the advantage of being elastic, but the moral effect of putting the men on their honor, so to speak, was such that no abuse of their privilege occurred. The average amount of work done per day was more than before, incidentally showing that good-will is a very potent factor in the shop.

Newark, N. J. F. EMERSON.

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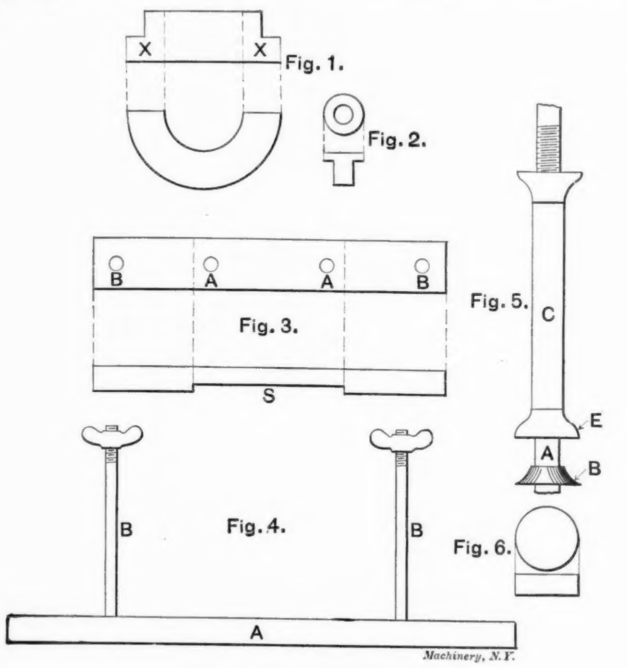
REMODELING A STEAM AUTOMOBILE.

Editor MACHINERY:

In the sketches shown herewith Figs. 1 to 4 inclusive show a method which was adopted in an automobile (steam) remodeling job. The engine as it came from the factory was equipped with ball bearings for the crank shaft and pins, but as it was very unsatisfactory in service, it was determined to replace the ball bearings with plain bronze.

Fig. 1 shows an end and top view of one-half of one of the main bearing brasses. It was deemed necessary for convenience in adjusting for wear that the brasses be fitted in halves and also that the two halves be "brass and brass" together when finished. After they were cast in halves as shown and planed and fitted together, the problem of fastening them together for boring and turning them confronted us. Figs. 2, 3 and 4 show the jig used for drilling the holes for the machine screws to hold the brasses together for turning and boring. Fig. 3 represents a flat piece of bar iron in which was planed a slot S wide enough to just fit a brass laid on the flat

side. Having ascertained the distance apart that the screw holes were to be, the holes A A were laid out and very carefully drilled and reamed, and into them were fitted two bushings like Fig. 2, one having a hole of the size of the tapping drill and the other for the outside of the screws. Holes B B were then laid out the right distance apart to allow the piece to slide up and down on the uprights B B shown in Fig. 4. These uprights were merely two rods threaded at each end and screwed into the flat piece A. To use the device, a half-brass was placed, rounding side down, on piece A, Fig. 4, and the piece shown in Fig. 3 was then slipped on the uprights and, after having the brass adjusted into slot S and fair with one edge of the piece, was firmly clamped in place by the thumb nuts shown on the uprights. One of the bushings shown in Fig. 2 was then placed in position and a hole drilled, then the bushing changed to the other position and the other hole



Some Simple Shop Jigs.

drilled. One size bushing was used for one-half of the brasses and the other for the remainder. To ream the holes for countersinking the screw heads to get them out of the way in turning, an old flat file was taken and for a short distance on the end was ground to fit in the hole drilled in the brass. This formed a guide for the flat reamer formed just above it. The file was held in the chuck on the drill press and made a very good substitute for a regular counterbore. The brasses were then threaded for the screws and after screwing together were handled in the regular way, being held in the lathe chuck for boring and then placed on a mandrel and turned on the outside to fit the engine frame. This jig was not made with the intention of being used very many times, but was constructed as the easiest solution of a difficult piece of work for a shop with limited facilities.

Figs. 5 and 6 illustrate another kink used on this same job. Fig. 5 shows the main features of the steering head, in making which the builders evidently were a little saving of material as they did not let the threaded portion of the upright extend far enough upward to allow the lock nut to be screwed on firmly, so as to hold the upper cone from working loose. We removed the upright rod A and placed it in the lathe and turned a new seat for the lower cone B about 3-16" further down. In assembling it was, of course, necessary to put the balls in their places, and while this was easy enough with the upper ones it was not so with the lower. It first looked as though it would be necessary to draw the water from the tank and tip the carriage bottom upward, but after a little thought the following expedient occurred to us. Taking a flat strip of sheet tin about ½" wide we bent it to a circle as shown in Fig. 6, which fitted snugly around the outside of cone B. This held the balls in place until ready to push the rod upward into position, when the tin was pushed off by contact with the ball cup and the balls, of course, were held by the cone.

While neither of these devices are strictly in the line of machine shop practice, they illustrate some of the methods used by small shops in uncommon work.

Spring Valley, Minn. EDWIN KILBURN.

* * *

TO CUT A 69-TOOTH GEAR WITH A 23-HOLE INDEX PLATE.

Editor MACHINERY:

Referring to E. J. B.'s method of cutting a 69-tooth gear with a 23-hole index, as described in the August issue, I think that if he had cut a tooth at every third hole, using the 23-hole index plate, for nine turns or revolutions of the same, he could have accomplished his object without so much trouble. This method of indexing would have given him 7 2-3 teeth for each revolution, which multiplied by 9 gives 69 teeth. In this way he could have cut 69 teeth without much trouble.

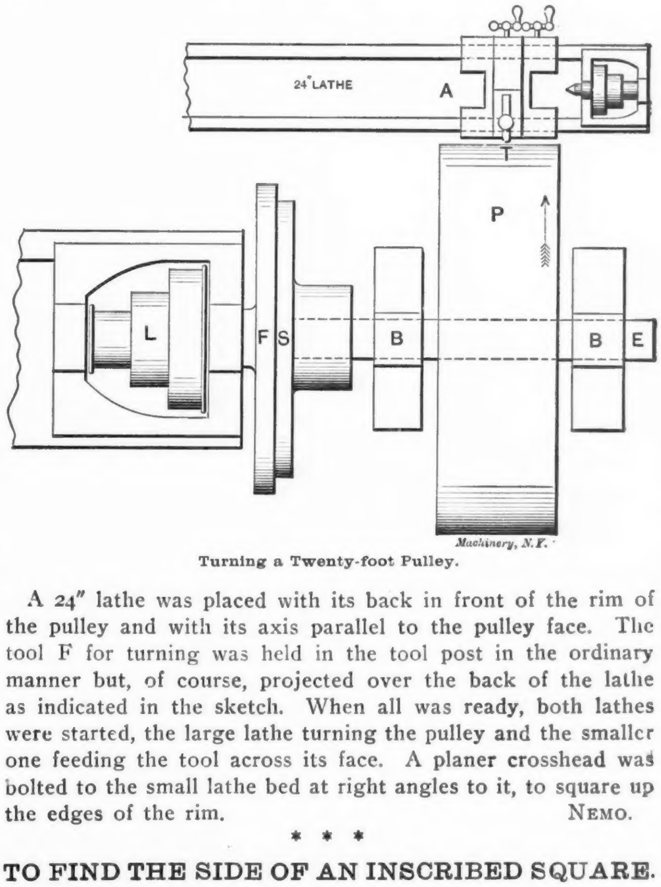
Newport, R. I. C. H. MARVIN.

* * *

HOW A TWENTY-FOOT PULLEY WAS TURNED

Editor MACHINERY:

The accompanying sketch shows how a twenty-foot pulley was turned by a combination of two small lathes. The headstock of the large lathe was turned around so that the face plate F overhung the end of the bed. Two bearings B B were erected on brickwork and set in line with the spindle. The pulley to be turned was keyed on the arbor E and a spider S was also keyed on the end of the arbor as shown. The arbor with the pulley was then mounted in the bearings and the spider bolted fast to the face plate.



Turning a Twenty-foot Pulley.

A 24" lathe was placed with its back in front of the rim of the pulley and with its axis parallel to the pulley face. The tool F for turning was held in the tool post in the ordinary manner but, of course, projected over the back of the lathe as indicated in the sketch. When all was ready, both lathes were started, the large lathe turning the pulley and the smaller one feeding the tool across its face. A planer crosshead was bolted to the small lathe bed at right angles to it, to square up the edges of the rim. NEMO.

* * *

TO FIND THE SIDE OF AN INSCRIBED SQUARE.

Editor MACHINERY:

In the October issue under the heading "How and Why," in answer to C. K., you give a method of finding the side of an inscribed square. As I practise a shorter way of getting the same result, I thought it would not be amiss to send it to you.

Simply multiply the diameter of circle by the decimal .707, and the product gives the length of side required. Should any of your readers have difficulty to remember the figures given above, they can find them in a table of sines opposite the angle of 45°.

I believe that in shops generally, at the present day, the principle of "the quickest way is the newest fashion" necessi-

tates that the mechanic be on the alert for every little kink that will help him "get there." WM. NEWTON.

Oneonta, N. Y.

[Since the constant .7071 is obtained by the same method as given in the answer to C. K., but using a diameter of 1, it will not come amiss to remember both the method and the constant.—EDITOR.]

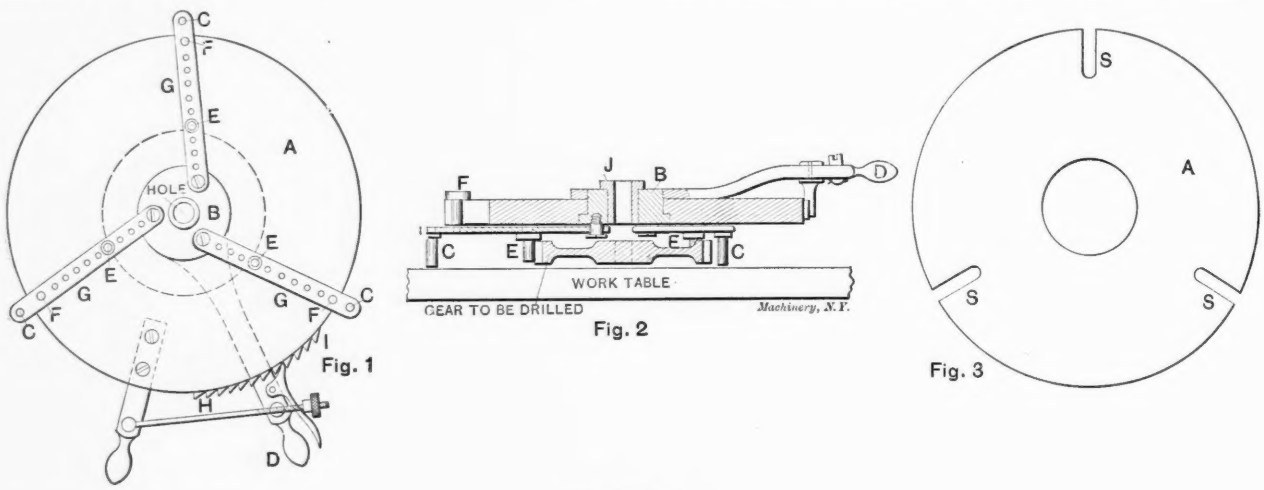
* * *

A UNIVERSAL JIG.

Editor MACHINERY:

The following is a universal jig that will prove to be worth its weight in gold to anyone having a lot of gear blanks, sprockets with cast teeth, pulleys, etc., to drill. Besides being very simple it is cheap, easily made, and will last for years. It can always be depended upon to do its work in a first-class manner. Its utility will be very evident to anyone who will examine the accompanying sketch.

Fig. 1 shows the working parts of the chuck. A cast-iron plate or disc A, Figs. 1 and 3, having a central bore for the reception of a wrist plate B, Fig. 1, forms the body of the tool. This disc A may be of any suitable diameter, say about 8 or 9 inches, for work of about 4" to 12" diameter, with a thickness of ½" or 9-16".



Details of Jig.

The wrist plate is set into the disc flush with the under side. The clamping lever D, Fig. 2, is screwed to the upper side of the wrist plate B, which is shouldered so that the lever forms a nut which holds the wrist plate in position. The wrist plate should be a nice fit. The disc has three equally distant slots milled in its circumference, each about ½" x 2", S S S, Fig. 3. These slots form the guides for the outer ends of the jaws. A shoulder screw F, Fig. 2, the body of which is turned to fit the slots S S S, holds the jaws in position against the disc and allows them to be drawn towards the center by the wrist plate.

The jaws, G G G, Fig. 1, are made of ⅜" or ½" x 1" machine steel. They are secured to the wrist plate by shoulder screws. They may be made of any length to suit the work. The legs, C C, Fig. 2, support the tool in a horizontal position. The jaw studs, E E, Fig. 2, may be made long enough to serve as legs if the variety of work will allow.

In place of the ratchet H I, Fig. 1, I sometimes use a long bolt with a thumb nut, as shown, to draw the two handles together. The bolt may be made of ⅜" cold-rolled steel and should be long enough to reach between the handles when the jaws are extended. It should be hinged to a swivel post in the disc handle and should also have a slotted swivel post in the clamping lever to draw through. A set of tool-steel bushings of suitable sizes fit the central hole in the wrist plate, as shown at J.

To use, place the work to be drilled on the drill-press table and place the chuck or jig over it. Press the handles together to lock them and then go ahead and drill.

I have made these jigs for several years for all kinds and sizes of work. Little ones 5" in diameter for drilling wheels for cast-iron toys and two larger ones with 32" discs and 16 and 18 jaws for trueing bicycle wheels. I have never heard anything but praise for them.

Audubon, N. J. J. EDWARD BARRETT.

BORING BAR WITH HELIX TO EJECT CHIPS.

Editor MACHINERY:

I suppose some of your subscribers have tried to bore a long hole with a boring bar having a stationary cutter, where the hole to be bored was so near the size of the bar that the chips gave them trouble by filling up the bottom of the hole and making the tool cut deeper on top. Now the best kink I have ever seen to overcome this is to take a piece of brass spring wire and wind it around the bar in the form of a thread of a very coarse pitch, for a 3" bar, say, one turn in 3". Start the spiral just back of the tool by drilling a hole in the bar about the size of the wire and bending the wire at right angles, and insert the end in this hole. After winding, fasten the other end in same way. The wire is to be wound the opposite direction from the kind of thread the lathe would cut with the carriage moving in the same direction; that is, if the carriage were moving ahead so as to cut a right-handed screw, wrap the wire left-hand and vice versa.

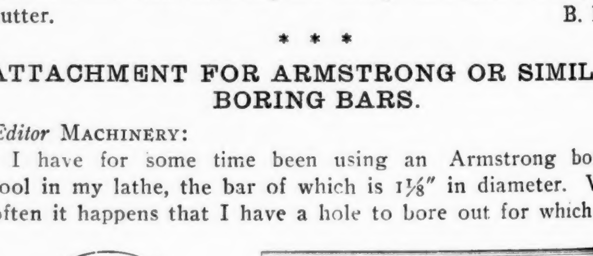
Another kink with this kind of boring bar consists in setting the tool, especially if the tool is held in with a key. Instead of placing the bar on the lathe centers, put one end in the chuck and set the tool nearly the size, which can be done without much trouble. Now bring it to cut the right size by throwing the end of the bar over in the chuck. In this way you can adjust your tool very easily and quickly, and there is not the danger of shifting the tool when driving the key. Of course, this will not work with any bar except one with a stationary cutter. B. L.

* * *

ATTACHMENT FOR ARMSTRONG OR SIMILAR BORING BARS.

Editor MACHINERY:

I have for some time been using an Armstrong boring tool in my lathe, the bar of which is 1⅛" in diameter. Very often it happens that I have a hole to bore out for which the



Tool Holder.

bar is too large. In such cases I have had to go back to forged tools, with the result that for nearly every job of the kind a new tool has to be made, the last ones made being too short or so long that there is too much spring. To overcome this I turned up a couple of pieces of steel to fit the boring bar holder, and in one of them I drilled two holes as shown in the cut, ½" and ⅜", and then sawed it down through A A, and also between holes to allow it to spring together. In the others I drilled a ¾" hole in one and 1" in another, drilling the ¾" hole to one side of the center as far as possible

Then I got a set of tools forged about 8" or 10" long out of round steel, of ⅜" and ½" diameter. In the ¾" and 1" bars I used inserted cutters of ¼" and 5-16" square steel, self hardening. The object in boring the holes to one side is that the bar or tool may be easily raised or lowered by unclamping it and slightly turning the bushing, and without touching the tool post. With this set you have all sizes of tools generally necessary, and the length may be quickly adjusted to suit the job without any waiting on the tool dresser.

B. L.

* * *

DEVICE FOR MILLING A SQUARE HOLE.

Editor MACHINERY:

A short time ago I was in a shop where I used the device shown in the accompanying sketches for milling square holes in some plates. Each plate required a square hole 2" x 1" for a slide that was to operate perpendicularly to the surface.

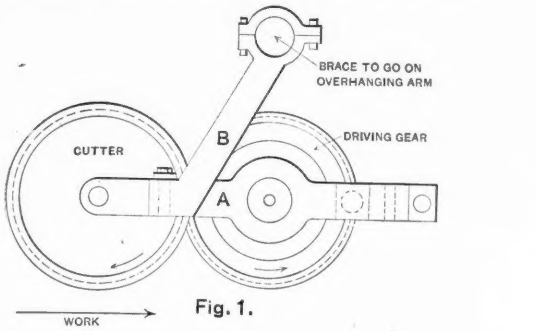


Fig. 1.

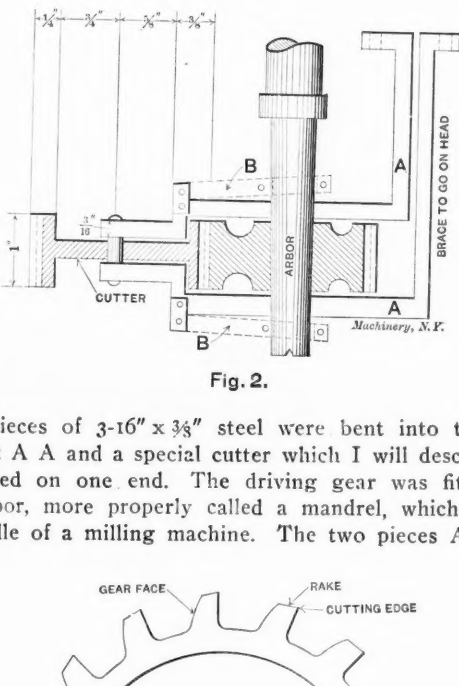


Fig. 2.

Two pieces of 3-16" x ⅜" steel were bent into the shape shown at A A and a special cutter which I will describe later was bolted on one end. The driving gear was fitted to a taper arbor, more properly called a mandrel, which fitted in the spindle of a milling machine. The two pieces A A were

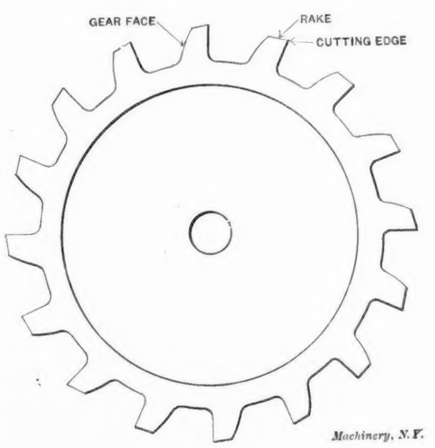


Fig. 3.

screwed to the head of the machine and the two pieces B B were fitted to clamp to the overhanging arm. The purpose of the pieces B B was to prevent the cutter from vibrating and thus enlarging the hole cut.

In making the cutter, a piece of tool steel was turned and a gear was made out of it. Then one side of each tooth was cut away to form a cutter as shown in Fig. 3. The cutting edge was given both rake and clearance as shown. This rig can be used for any size of hole in ½" stock larger than 1¾" x 1". If the hole is any smaller the center of the cutter cannot pass clear through the stock. The size of the hole depends entirely upon the thickness of the stock.

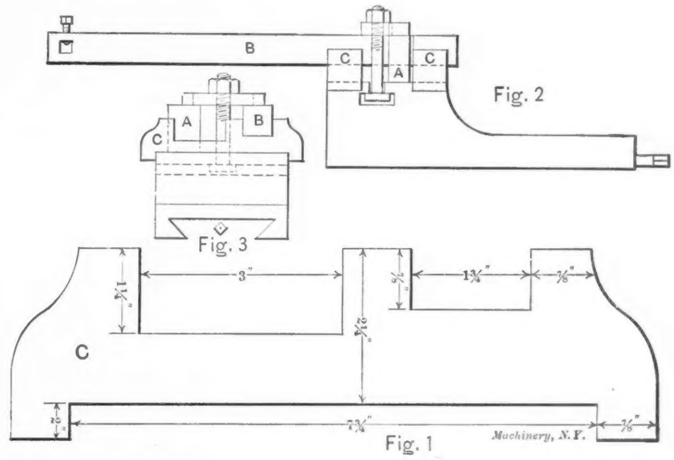
TEDDY.

* * *

BORING-BAR HOLDER.

Editor MACHINERY:

The accompanying sketches represent a boring-bar holder which I have used on a lathe of about 42" swing. The boring bar was of soft steel of square section with a ¾" square mushet steel tool. The piece shown in Fig. 1 was of cast iron planed to shape. There were two of these pieces and they were made to take two sizes of boring bars, and were a light drive fit on the top of the tool slide, the tool post being removed when the rig was used. The two slots were planed in both pieces at the same time in order to bring them in line and were made



so as to be a tight fit to their respective sizes of boring bar. The pieces C C were put on the tool slide as shown in Fig. 2 of the sketch, and Fig. 3 is an end view. The swivel rest was turned parallel with the lathe shears, as shown, in order to prevent it from projecting too far in front of the lathe on heavy work. A bolt was put in the T-slot and a block of the proper height was put under one end of a clamp, the other end resting on the bar B, which was thus clamped rigidly in place. By this arrangement, the bar was locked positively in place, the only movement besides the feeds being due to the spring of the bar.

E. J. H.

Washington, D. C.

* * *

COMPOUND INDEXING ON THE MILLING MACHINE.

Editor MACHINERY:

I received a letter from one of the readers of MACHINERY, in regard to my article on indexing in the April, 1900, number, in which he states that he cannot make it come out right for gears of 73 or 79 teeth or any prime number, and he wished me to explain how it was done. As the matter may be of interest to others, I concluded to send my answer to MACHINERY.

It used to be supposed that only certain divisions could be obtained on the milling machine by using the index plates furnished with the machine, and when a gear was to be cut with an odd number of teeth of a greater number than 49 it was thought that it could not be done exactly, although by setting the cutter off center, and using the cross slide, one or more teeth could be added or subtracted from the number for which the machine was indexed. But as the Brown & Sharpe universal milling machine was used extensively, its possibilities were found out, and it was discovered that, by using two circles of holes and making either two forward moves, or a forward and backward move, any number of divisions of the circle could be obtained, which, while many were only approximate, were accurate enough for all practical purposes. Tables were made for the Brown & Sharpe milling machine book for any divisions likely to occur in practice, with the

moves, error, and times around. How these tables were obtained I will attempt to explain.

What is known as the one-hole basis is founded on the number of divisions, which can be obtained by moving forward one hole on one circle and backward one hole in another.

Thus $\frac{1}{47} - \frac{1}{49} = \frac{2}{2303}$ and $\frac{1}{40} \times \frac{2}{2303} = \frac{1}{46{,}060}$ and the greatest number of divisions obtainable on the one-hole basis is the reciprocal of this or 46,060. To attempt to work out a table by arithmetic alone would involve considerable extra labor, and here is where algebra becomes useful. I hope those who are interested and do not understand algebra, will not stop reading at this point.

Let a = No. of holes in outside row—say 49.

Let b = No. of holes in inside row—say 47.

A forward movement of one hole on inside row and a backward move of one hole in outside row would move the worm shaft forward an amount equal to $\frac{1}{b} - \frac{1}{a} = \frac{1}{47} - \frac{1}{49}$ Now in order to subtract we must make the denominators alike. $a \times \frac{1}{b} = \frac{a}{ab}$ and $b \times \frac{1}{a} = \frac{b}{ab}$. Now $\frac{a}{ab} - \frac{b}{ab} = \frac{a-b}{ab} = \frac{2}{2303}$ and $\frac{1}{40}$ times this $= \frac{1}{46{,}060}$ as before. The number of teeth is the reciprocal of this or $\frac{40\,ab}{a-b} = 46{,}060$ This is the formula for the one-hole basis; a and b may be any other circles as well. As an example, required to set the index for 93 teeth. First make groups of the factors in 40, with two of the circles of holes on the index plates at a time. If the back stop pin is not adustable (as is usually the case) we are limited in the backward moves to the circles in the index plates in which the pin goes; they are usually 49, 33 and 20. We look over the factors in the various groups that correspond with the factors in 93, which are 3 and 31, and find them in the group of the 33 and 31 hole circles and 40 thus:

$$\begin{aligned} 40 &= \cancel{2} \times 2 \times 2 \times 5 \\ 33 &= \cancel{3} \times 11 \\ 31 &= \cancel{31} \\ \hline & 2 \times 2 \times 5 \times 11 = 220 \end{aligned}$$

We strike out the factors of 93 and the factor containing the dffference of the two circles, which is 2 and get 220. To prove that this is correct, substitute the figures in the formula $\frac{40\,ab}{a-b} = \frac{40 \times 33 \times 31}{2} \div 93 = 220$ holes. This means we are to move forward 220 holes on the 31 hole circle and backward 220 on the 33 circle. $220 \div 31 = 7\frac{3}{31}$ moves forward, and $220 \div 33 = 6\frac{22}{33}$ back. Taking out the 6 whole turns we have $1\frac{3}{31} - \frac{22}{33}$. But these moves can be shortened, which is desirable as there is no sector on the back of the index plate, and it would be inconvenient to count 22 holes each time. We can subtract (algebraically) one whole turn from the forward move, and add one whole turn to the backward move, without changing the accuracy of the result, and get moves more convenient to make.

Thus

$$\begin{array}{r} 1\frac{3}{31} - \frac{22}{33} \\ -\frac{31}{31} + \frac{33}{33} \\ \hline \frac{3}{31} + \frac{10}{33} \end{array}$$

And we have only to move forward 3 holes on the 31-hole circle, and then to move forward also 10 holes on the 33-hole circle, so that this expedient changes the direction of the move as well as shortens it.

In some cases it is not necessary to use the compound moves more than once or twice. Thus, for a gear of 96 teeth the index could be set for 48 and after going around once, use the compound moves for 96, which are $\frac{3}{18} + \frac{5}{20}$ and then cut the 48 teeth the regular way.

INDEXING FOR PRIME NUMBERS.

Prime numbers above the index plates cannot be cut consecutively, unless an extra move in addition to the compound moves is made after cutting several teeth, which is not convenient. Other numbers can usually be, however, if the back stop pin is adjustable. Thus for 51 teeth the Brown & Sharpe table gives $8\frac{41}{47} - \frac{12}{49}$ and the times around 11. But if the back pin is adjustable the teeth can be cut consecutively. Looking for the factors of 51 (3×17) in the index circles, we find them in the group of 40 with the 18 and 17 hole circles, and after striking them out, and dividing, etc., as before we get $1\frac{2}{17} - \frac{6}{18}$ By adding 1 turn to the backward move and subtracting 1 turn from the forward move we have $\frac{12}{18} + \frac{2}{17}$. We can do the same with 57 divisions which are found in the group of factors of 40, and 18 and 19 hole circles, and the same with 63 and others. It ought to be an easy matter to rig up a contrivance to have the back pin adjustable. Indeed, it seems necessary even with the Brown & Sharpe table, as some of the divisions require the back pin to go in circles of 49, 47, 41, 43 holes, etc., unless we use the back pin for the forward movements, and this is not so convenient, as there is no sector to aid in counting the holes by bringing up against the back pin. In connection with this it is important to know that Mr. Fred J. Miller holds a patent on index centers in which the back pin is adjustable. For indexing prime numbers we must use other than the one-hole basis. We will find that $\frac{24}{49}$ of a turn forward and $\frac{23}{47}$ of a turn backward gives a forward movement of index pin $\frac{1}{2303}$ and multiplying by $\frac{1}{40}$ we have $\frac{1}{92120}$ and the number of divisions = 92,120, the largest number possible using any two of the index circles furnished with the machine. For a little digression, suppose we were to divide a circle or cylinder in parts by lines and spaces each .003 wide. The enormous number of divisions would require a circle $\frac{.006 \times 92120 \times .3183}{12}$ = 14 ft. 8 in. in diameter.

To resume: Suppose it is required to cut a gear of 59 teeth. $92{,}120 \div 59 = 1561\frac{21}{59}$ then $\frac{1561\frac{21}{59}}{92120} = \frac{1561\frac{21}{59}}{2303}$ of a turn of index pin to give $\frac{1}{59}$ of a revolution of main spindle.

Multiplying $1561\frac{21}{59}$ by 11 gives $17174\frac{54}{59}$; calling it 17175 makes only a slight error, which I will explain subsequently. This makes it necessary to go around the circle 11 times. As we are working on a basis of $\frac{24}{49} - \frac{23}{47}$, multiplying $\frac{24}{49}$ by 17175 gives $8412\frac{12}{49}$ turns forward and $\frac{23}{47} \times 17175$ gives $8404\frac{37}{47}$ backward. Taking out the 8404 whole turns leaves $8\frac{12}{49} - \frac{37}{47}$. Subtracting and adding one whole turn gives $7\frac{12}{49} + \frac{10}{47}$. To find the error $\frac{17175}{92120} \times \frac{1}{11} = .016949241$. $1 \div .016949241 = 58.997$ divisions. $\frac{1}{59} = .016949153$. $.016949241 - .016949153 \times 59 =$ error in circumference for 59 teeth, which is .0000052. For a gear of 1 diametral pitch of 59 teeth, the circumference = 185.3544″. $.0000052 \times 185.3544 = .0009 =$ error in position of last tooth cut if the cross slide be not moved. If a gear of finer pitch is to be cut, divide .0009 by the pitch. If the error is of sufficient magnitude to be taken into account, we could move the cross slide of the machine to correct it. If the index head (as in this case) was set for a smaller number of moves than the desired ones, the larger of the two moves will carry the top of the blank in the opposite direction from that in which the cross slide should be moved. In this case we could move the cross slide .0001 after every 6 cuts.

For another example: To cut 79 teeth, we find that $\frac{8}{49} - \frac{7}{43} = \frac{1}{2107}$. $\frac{1}{40} \times \frac{1}{2107} = \frac{1}{84280} = 84{,}280$ divisions as a basis. The object in finding this new basis, is so that the 79 will divide into it with a smaller error than the preceding basis, $\frac{84280}{79} = 1066\frac{66}{79}$. $6 \times 1066\frac{66}{79} = 6401$ nearly; and we cut every 6th tooth, thus going around 6 times. $6401 \times \frac{8}{49} = 1045\frac{8}{49}$. $6401 \times \frac{7}{43} = 1042\frac{1}{43}$. $1045\frac{8}{49} - 1042\frac{1}{43} = 3\frac{8}{49} - \frac{1}{43}$. The error in this case is so small that it need not be taken into account.

If the above has been carefully followed almost anybody ought to be able to make a table for himself.

East Providence, R I. JOHN T. GIDDINGS.

* * *

Ladies about to do their fall sewing are advised by a writer in Harper's Bazar to get their sewing machines ready a day ahead of time, "so that the oil will have chance to penetrate around every intricately located screw." We think they should better lubricate the "intricately placed screws" with something a little quicker in penetrating the "intricacies" than an oil that requires a day, lest locomotor ataxia be their fate.

LETTERS FROM ABROAD—2.

PARIS EXPOSITION—TOOLS, NOVELTIES, TRANSPORTATION.

Editor MACHINERY:

After returning from the Continental trip previously referred to, a month's sojourn in Paris, with every day faithfully spent at the Exposition, gave opportunity for a more or less careful inspection of the exhibits, although their number is so enormous that a thorough examination of all would require many months of tiresome work.

Excellence of American Machinery.

On the whole, the machinery exhibits are magnificent, notwithstanding the difficulty of finding where they are located, on account of the wretched classification before referred to. The greater part of the American machine tools are shown in the special building erected by the manufacturers thereof, for their own use, at Vincennes Park. These exhibits are mostly by first-class makers of well-known reputation, and do not need description here, as they show the best work and most recent designs of standard American tools, chiefly in the way of lathes, planers, shapers, slotters, milling machines, horizontal and vertical boring mills, gear cutters, turret lathes, screw machines, etc., etc.; together with a variety of presses for punching, cutting, drawing, embossing and so forth. The energy displayed by the combined American manufacturers in erecting and equipping the building, situated in such an out-of-the-way location, and in the face of many difficulties, deserves much praise; but it is indeed a pity that this magnificent collection of machines, which makes machines to move the world, would not have been given space in one of the main buildings in the heart of the city, with European tools of the same character in ordinary proximity, for purposes of comparison.

In steam, hydraulic and pneumatic machinery my impression is that the American exhibits do not do us any credit, either in number or size, and the same may be said of textile machinery of various kinds. This paucity of exhibits is also more noticeable in the Transportation Building at Vincennes, where, among the hundreds of beautifully finished cars and locomotives from all parts of the world, America had scarcely a representative article.

In electric machinery the American exhibits are good, although not extremely numerous, and the same thing may be said for artillery and ammunition. These remarks are intended, however, to express casual impressions only, and do not form a carefully kept and statistical record of exhibits of various nationalities.

Features Good and Bad of Some European Exhibits.

It seems to me that the steam machinery of the European exhibits is on the whole very fine, in most cases showing designing work of a high quality; but the same thing can hardly be said in regard to some of the machine tools. One rather painful and "amateurish" specimen of machine design attracted my notice, where a medium size of milling machine, with heavy base and massive table of good proportions, dwindled away into an upward projecting column for carrying the spindle which was from 9" to 12" wide, but only 5" thick in the direction parallel to the spindle, to form the depth measurement of a beam for resisting the principal stresses. This beam depth should have been at least 12" or 15", but for the fact that mounted on it was a spindle about 1" in diameter, which should have been 3". This was driven by little ¾" spiral gears of ¾" face, which should have been more than twice as large, and with a face of 2" or more. Another machine showing similar bad proportions was a fairly creditable radial drill, with a very heavy bevel gear as the driven wheel upon the spindle, operated by a pinion at the rear upon the horizontal driving shaft, but having another enormous pinion and shaft in front, of about equal size, for operating the feed, which probably did not take a fortieth part of the power used for the main driving. Still more painful specimens of this proportion were to be seen embodied in power presses in several different exhibits, more especially in many of those made in France. Frames would be enormously strong in one place, with particularly weak spots in certain places falling within the line of major stresses. In some cases main shafts would be weak, where subjected to torsion, or cranks would be of half the proper strength where heavy bending stresses were to be expected. Worse than all were many of the pitmans, which, in medium sized punching presses, were in some cases as small as 1" in diameter, where theory as well as the practical experience of the writer would call for 2" or 2½", thus making them some four or six times stronger than was actually the case. Another bad feature of many of these machines was the extremely short slide bearings given to the ram. In some cases these were but 3" or 4" on a medium press, where the distance should have been 10" or 12". Many of these mis-proportioned machines, however, had a somewhat pleasing general form, and were beautifully finished, as far as polished work and finely cleaned, painted and varnished castings were concerned. A number of them attracted the special attention of the juries, and won gold and silver medals galore, on account of their general beauty and smooth running qualities—features which are easily obtained by designers of very moderate experience.

It will not do to say that such faults as are above mentioned do not exist in America, but with us I believe they are not nearly as numerous, and that the proper study of the strength of materials is not limited to our bridge- and ship-builders, but that to a reasonable degree, it guides also the work of our machine tool and engine builders.

The usual "fad" of European designers for spiral gear-teeth, mostly of the "herring-bone" pattern, is still in evidence as much as ever. The last mentioned pattern is, of course, better than a single spiral as it avoids end thrust. It is not, however, easy to make in cut gearing, and therefore is usually cast, even for nice machine tools. Surely the theoretical advantage of smooth running is far overbalanced by its lack of truth and accuracy. The American cut spur gear is, to my mind, vastly better and cheaper.

Two of the Largest Exhibits.

As no attempt is made in this article at a thorough and classified analysis of machinery exhibits, much further description of this sort may be left to other writers, or to an examination later of the official catalogues. A casual glance at some miscellaneous details that struck the writer as novel may, however, be of interest, but before taking note of these I will speak of the two biggest exhibits of all. These are the gigantic chimneys which carry the smoke from the boilers, furnishing steam for the motive machinery. They are situated respectively upon the east and west sides of the main building of the Champ de Mars, near its south end. I am informed that they are 262 feet high, with an outside diameter at the base of 40 feet, and an inside diameter of 20 feet, tapering to 14 feet at the top. Each chimney weighs about 17,000,000 pounds and cost over $40,000, having in it over 1,500,000 ordinary bricks, and a large number of special ornamental ones. These structures are each supported on an immense group of piles, driven 30 feet or so into the ground, and covered with a large mass of concrete. These chimneys are perhaps not particularly notable for their size, but are absolutely unique and wonderful for their splendid beauty of proportion, of coloring, and of detailed ornamenting, being noble works of art in themselves, and worthy of preservation for generations as monuments to the wonderful industry, perseverance and elevated tastes of their designs and builders. It is earnestly to be hoped that they will be allowed to stand, and not be ruthlessly torn down to take their share in the awful wreck which is soon to happen among a group of some of most beautiful structures in the world.

Among minor novelties (to me at least) were large rolls of belting, some 8¼ feet wide by ⅞" thick, and of great length, which were made up in layers of leather ⅞" wide, with their edges forming the working surfaces, being fastened together with cement, and with slim rivets running all the way through in the direction of the width. There were also belts 40" wide, thickened at each edge into double belts about 10" wide, the middle being left thin. A number of double belts exhibited were sewn at each edge with raw-hide, rather than depending upon cement and ordinary sewing or rivets. A triple thickness belt 12" wide was shown with three 4" sections placed edge to edge with other sections, breaking the points with the same. That is to say, the different layers were piled up in the man-

ner of brick work, and everything was then laced and riveted together, with the lacing running the whole length in various lines. Among some exhibits of belting and other such articles I discovered a unique little turret machine, which seemed, in the words of Lord Dundreary, to be "flocking by itself all alone." This had been doing work of various kinds such as making shirt-studs and pencil cases, the latter having loose revolving ends securely swivelled upon them. More strangely, however, when I saw it, it was making watch-chains, each link consisting of an ordinary bulb-shaped piece of brass, or steel, with a projecting neck and ball-head at the end thereof, the bulb of the next link having a cylindrical hole, with a spherical termination at the large end, being closed on to the head of the first link loosely enough to both swivel and swing in all directions, thus forming a complete revolving ball and socket joint between each pair of links. All this was done automatically in the machine, the rod going in and the chain coming out completed through the spindles. It must be explained that the machine had two spindles, which moved laterally, one supplying partly finished work to the other. The trick of putting the links and other pieces together of course consisted in the machine burnishing down the thin edge at the outer end of the hole and thus compressing the metal to a smaller diameter around the ball head of the next link.

Another interesting article attracting my notice was cylindrical driving chain of various sizes, used in the place of round belts. Each link was of a length equal to two or three diameters, and was rounded off with a spherical end. One end was then slotted, and the other end slabbed off to leave a tongue of the same width as the slot, but standing at right angles therewith. Then a number of these links were put together, and rivets put through them to connect them, at right angles to the slots, and about one-half the diameter of the chain from each end of the links. A very smooth semi-flexible cord was thus formed and one that was, moreover, capable of bending at short intervals in various directions.

New Modes of Transportation.

Considering the different methods of transportation in Paris, the most unique thing, to Europeans at any rate, is the moving side-walk which extends for more than a mile around a space of approximately triangular contour mostly within the Exposition grounds, and which serves to carry passengers from various points in the Champ de Mars to the buildings in des Invalides. This, as is well known to people who visited the Chicago Fair, and saw the platform there running, consists of a stationary platform, a moving platform, 3' or 4' wide next to it, which moves about five miles an hour, and a second moving platform still farther from the stationary one, which moves about ten miles an hour. The latter is provided with an occasional seat, being in this respect, not so good as the one at Chicago, which had pews about like a church. Each platform is provided with numerous ball-headed posts, which can be grasped by the women and children, who seem determined to turn around and step on backwards, or tumble on, or roll on, or get on somehow or anyhow except in the proper way of simply stepping on while facing in a forward direction. In this case the whole scheme is perfectly convenient, and is in my opinion the coming system, perhaps in some future generation, for rapid transportation in cities. To become this it will want to be somewhat glorified from its present crude form, which moves roughly and is quite noisy. Mechanically speaking, however, there is no difficulty whatever in running platforms of this kind with much closer contact than in the present case, almost entirely without noise, and have them made with smooth foot-plates of India-rubber, or similar material. Furthermore, there might just as well be three or four moving platforms instead of two, thus enabling those who reach the final goal of speed by the simple act of stepping sidewise for two or three seconds, to get where they want to go with remarkable alacrity. Should the final platform be furnished with comfortable seats and canopies, such a method of traveling would truly be ideal.

It is a matter of interest to the writer, if not to his readers, that he designed a platform of this kind some twenty odd years ago, and filed a set of drawings thereof, not, however, taking out a patent. As far as he was concerned, he allowed it to become an abandoned invention, but was pleased to have the compliment paid to his ideas when a similar device was installed at Chicago, largely through the energy and inventive ability of Mr. Max Schmidt, who also appears as one of the authors of the present platform at Paris, which, by the way, attracts a great deal of attention, and is carrying an enormous number of visitors. The writer did not, however, feel quite so happy, nor quite so original, when, upon investigating the patents for this device, he discovered that some other man, by the same name of Smith, in England, had invented and patented the same thing still another twenty years earlier. The fact of the matter is, that, although the device is no doubt excellent, and destined for a great future, the world is as yet not quite ready for it, principally on account of its enormous expense. The time has come, however, when it is entirely practical to run a platform of this sort of any length, by reason of the wonderful facility which a connected gang of electric motors give for the smooth driving thereof, and its absolute control from any one point. In the days when the elder Smith conceived the idea, and, later, when the writer independently thought of it there were no electro-motors, and a complicated series of engines, with connecting shafts, chains and other gearing, had to be contrived, making it really an impracticable thing for long distances.

Near the moving platform in question is a modern American electric railway, running in the other direction, thus giving passengers a good chance for moving to distant parts of the Exposition wherever this route covers the ground.

At various places inside the Exposition are moving stairways or inclined planes of considerable novelty to Europeans, but which have been used for some little time in this country. One of these is a complete stairway, the individual steps of which disappear gradually at the top and bottom. It seems an excellent device, but is doubtless quite expensive. Other exhibits of this sort, which are quite numerous in several of the various Exposition buildings, are simply traveling rubber belts. They cannot be set at so steep an incline as can the stairway, but they seem much cheaper and simpler, and are very comfortable to ride upon, either standing still, or walking. In either case the hand rails move with them at the same speed. From the fact that these rubber belts work so well, it is probable that a smoother and better arrangement for the moving platform, as above referred to, may in time be contrived.

Aside from the devices just mentioned there seems to be little else new in the way of transportation in the Exposition itself. There are a few ordinary elevators in some parts of the buildings, those in the Eiffel Tower seeming to be about the same as they were in 1889, and changes of cars on the way up are required, with considerable delay in getting to the top.

The matter of transportation outside of the Exposition might well be the subject for an article by itself. Suffice it to say here that automobilism is rampant, and there is no place in the world where so many of these machines, of so many degrees of goodness and badness, and of beauty and ugliness, can be found in a given space, and mostly going at the top of a rather topmost sort of speed.

OBERLIN SMITH.

* * *

BOOK NOTICE.

Dynamo Electric Machinery, by Samuel Sheldon, A. M., Ph. D., Professor of Physics, Brooklyn Polytechnic Institute, assisted by Hobart Mason, B. S. Published by D. Van Nostrand, 23 Murray street, New York. 281 8vo. pages, illustrated. Price $2.50.

This work is attractively prepared and impresses us as one that will prove of value to the engineer as well as to the student. The first two chapters are devoted to an explanation of the magnetic laws, and then follow treatments of the different parts of the dynamo, like the armature, field magnets, etc., a discussion of motors, the management of machines, the design of machines, etc. Mathematics are freely used, which makes the book of value to the designer who is looking for a scientific treatment of the main principles of generators and motors. The treatment is sufficiently explicit, however, without being what is generally termed "popular," to prove instructive to one not well versed in higher mathematics. It is a comprehensive, well-prepared treatise, condensed, but reasonably complete. The direct current only is considered.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

METHOD FOR REMOVING BROKEN FOLLOWER BOLTS.

Jas. F. Gillespie, New York City, gives a kink from a country engine room which has served him in the city machine shop as well. A is an engine piston with a broken follower bolt as shown in section at the bottom at G. C is another bolt of the same pitch of thread but not necessarily of the same diameter. B B are two hardwood blocks bolted firmly together and bored out as shown at D, Fig. 2, somewhat smaller than the bolt so

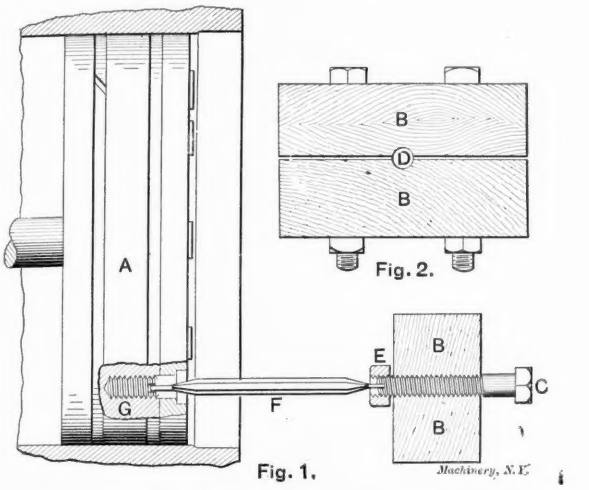


Fig. 2.

Fig. 1.

as to give a full thread when the two blocks are clamped together on the bolt C, and the latter screwed back and forth a few times. A slot is cut in the end of the broken bolt G, and a similar one in the end of the bolt C. A tool is made like F out of a chisel or other convenient piece of steel, each end being made similar to a screw-driver. The end engaged in C is held from slipping off by the nut E being screwed on a few threads as shown. The blocks B B are firmly held in some convenient manner in line with the broken bolt with the piece F in place, and a wrench is used to unscrew the broken piece.

It is possible with the parts made of wood as described, to remove a bolt that has been in place for years. If care is taken in cutting the slot in the end of the broken bolt, the effect will be to jar it loose instead of upsetting it in the hole, as might be thought. If wood blocks are used, they should, if possible, be threaded for three or four inches. Iron is, of course, better, but the wood blocks can be quickly rigged up anywhere. A rig of this kind can be applied while the average man is setting up a ratchet drill and there is no risk of running into and ruining the thread.

TO STIFFEN A BORING BAR WHEN USED ON FACE-PLATE WORK.

R. P. Perry, Hoboken. N. J., says:

"While I have never had occasion to use the rig shown in the accompanying sketch and have never seen it used by others, it has often been suggested to me when observing heavy face-

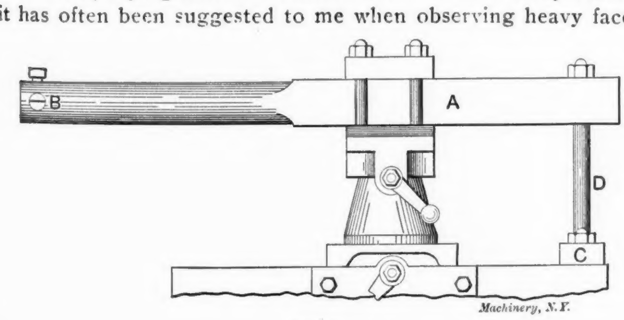


Fig. 3.

plate boring being done in the ordinary manner. The strain on the carriage and cross slide is very severe, especially when boring such work as locomotive driving boxes which give an intermittent pressure on the tool. The continual vibration wears the slides and probably does more to destroy the fitting and alignment of the crossways than ten times the same amount of ordinary work.

"With the simple rig shown it is necessary to have the boring bar somewhat longer than ordinarily made. A bar of wrought iron is bolted across the carriage at the tailstock end, with a slotted hole in the middle for the bolt D. The slotted hole allows the bar to be adjusted for considerable movement transversely by loosening the bolt, but for slight adjustments it would not be necessary to slacken it. Such a rig would materially stiffen the carriage and bar and make the tool able to stand a considerably heavier cut than is usually possible."

A CONVENIENT WIRE DRILL AND TAP GAGE.

M. N. Ball, Lansingburg, N. Y., says that the tool shown in Fig. 4 is similar to the ordinary drill and steel wire gage in common use, but has additional tap drill sizes and a sliding jaw graduated for 1½". The sliding jaw is made of material the same thickness as the plate and is kept in place by thin plates riveted to the gage on both sides of the sliding jaw and by the friction spring S. The spring is sufficiently strong to

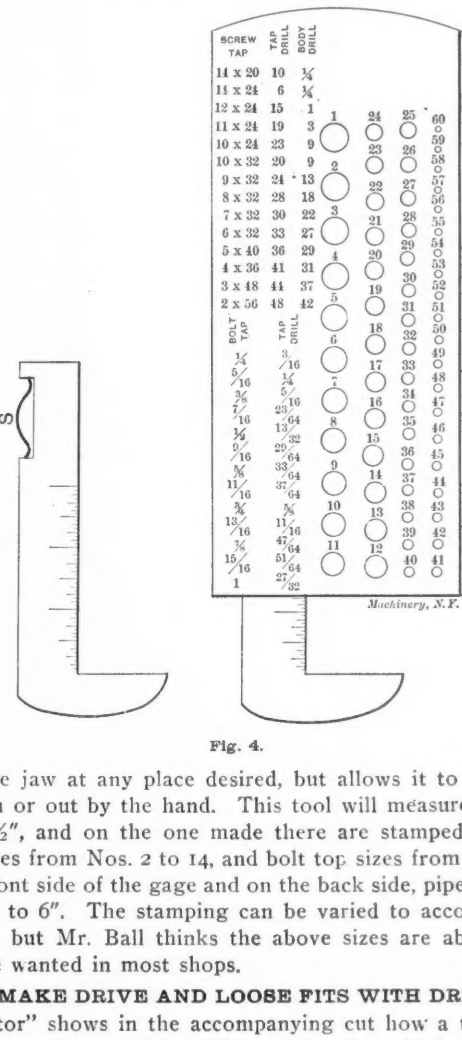


Fig. 4.

retain the jaw at any place desired, but allows it to be easily moved in or out by the hand. This tool will measure all sizes under 1½", and on the one made there are stamped machine screw sizes from Nos. 2 to 14, and bolt top sizes from ¼" to 2" on the front side of the gage and on the back side, pipe tap sizes from ⅛" to 6". The stamping can be varied to accommodate the user, but Mr. Ball thinks the above sizes are about what would be wanted in most shops.

TO MAKE DRIVE AND LOOSE FITS WITH DRILL.

"Monitor" shows in the accompanying cut how a twist drill may be ground to get either drive or loose fits. If, for instance, a driving fit is wanted for a ¼" rod, grind off the sides of a ¼" drill as shown at B, which thereby slightly reduces the cut-

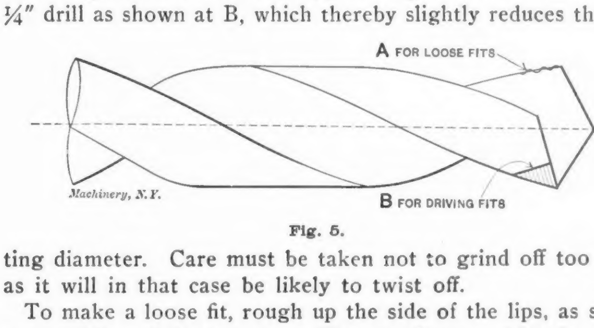


Fig. 5.

ting diameter. Care must be taken not to grind off too much as it will in that case be likely to twist off.

To make a loose fit, rough up the side of the lips, as shown at A, with a light hammer. The roughness, which is shown exaggerated, has the effect of making the drill cut larger than its normal diameter. A hole can be made larger than the drill

by grinding it off center, but in breaking through the metal, a portion of the hole is always left of the same diameter as the drill.

A SIMPLE CENTER INDICATOR.

Louis E. Salmon, Providence, R. I., shows how a reliable center indicator may be made out of a piece of wire, which will answer all purposes as well as a more elaborate one. Take a piece of ¼" thick flat stock, thin one end down and bend it as shown at A in the accompanying sketch. Make a good deep center punch mark on the side of the thinned end for the point of the indicator. To make the indicator needle, take a piece of 3-16" steel or iron wire 14" long and make a reverse bend

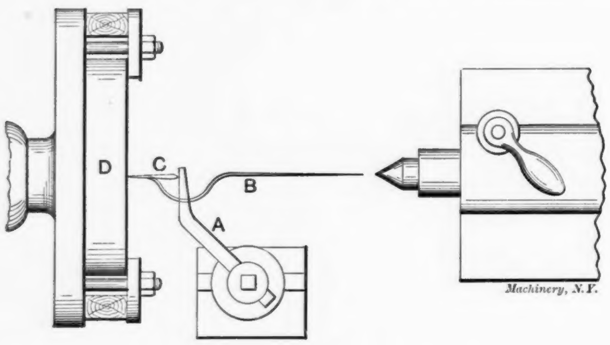


Fig. 6.

with its center about 4" from one end. Now heat the short part over a blast 2" from the end and bend it back so that the point will come beneath the center of the bend as shown at C. Sharpen the points and the indicator is complete. Care should be taken to have the point C a little short of the center of the bend in order to allow the latter to rest evenly on the piece A. The points must also be gotten in line. The sketch shows the indicator being used to center the piece D on the face plate and should need no further explanation.

SPOON FOR HANDLING AND COUNTING BICYCLE BALLS.

J. E. Storey, Manchester, Eng., sends the sketch which shows a spoon for counting and placing balls into bearings. It consists of a piece of strip steel bent to a V-section, and fixed to a hook handle also made from strip steel. The V-piece is made the proper length and width to hold just the required quantity and size of balls. The spoon can be filled as easily and as quickly, from a boxful of balls, as a spoon with sugar from a sugar basin.

Fig. 7.

Besides counting the balls accurately, it is better and quicker for placing them in the ball race than the use of the fingers, as it leaves less chance of the balls dropping between the spindle and barrel. It is excellently adapted for the use of makers of cycles, etc., in assembling hubs and pedals as shown in sketch. It need cost only a few coppers, as it can be made easily in half an hour.

MANDREL FOR COILING WIRE SPRINGS IN THE LATHE.

Fred. J. Hendricks, Trenton, N. J., describes a method for making coil springs which he says is original and very effective. A lathe center is fitted to the live spindle and a ½" hole drilled as indicated in the sketch, the proportions shown being about right for coiling springs from 3-64" wire, with an internal diameter of 1-16" and an external diameter of 5-32". From the termination of the ½" hole in the mandrel a 1-16" hole is drilled through the piece and from the other end a 3-16" hole is drilled in for a distance of about 3-16". A hole is drilled from the side of the mandrel at such an angle as will

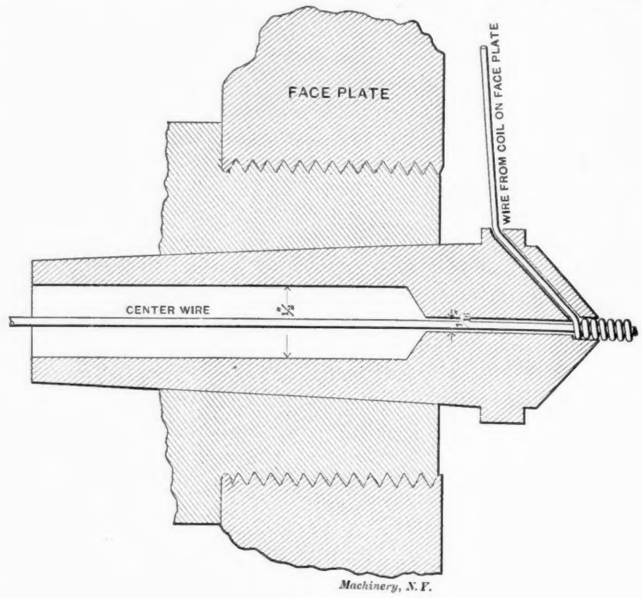


Fig. 8.

allow it to intersect the 3-16" hole at its termination. This hole is for the wire to be coiled, a small reel of wire being mounted on the face plate of the lathe so that it can unwind freely. The center wire is the mandrel and runs through the hollow spindle of the lathe, being supported by a reel at the rear. Coil springs can thus be made in thirty or forty foot lengths without difficulty and of any size desired by making the lathe center to suit. When the rig is properly adjusted, the spindle can be run at high speed when coiling.

GRADUATING TOOL.

"Auto" sends the accompanying sketch of a tool which has been found useful for doing graduating in a universal milling machine. The graduating tool A is pivoted on the pin B and is

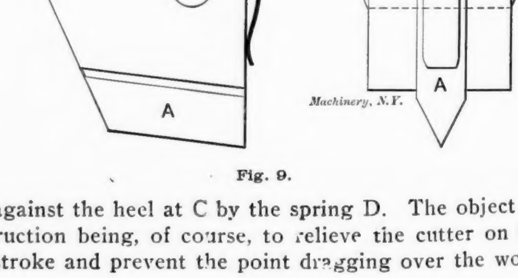


Fig. 9.

held against the heel at C by the spring D. The object of this construction being, of course, to relieve the cutter on the return stroke and prevent the point dragging over the work.

* * *

LOOK OUT FOR THIS SWINDLER.

A man named Hall has victimized a great many machinists and others in the states of Ohio, Illinois, Massachusetts, Pennsylvania and New York by claiming to be an agent of MACHINERY, and promising a dictionary as a premium to subscribers. All our agents carry written authority to collect, and none are authorized to make the offer above mentioned. Ten dollars reward will be paid any one who succeeds in having this swindler arrested and convicted.

ITEMS OF MECHANICAL INTEREST.

NOTES GLEANED FROM VARIOUS SOURCES.

Wireless telephony is now said to be an accomplished fact. It is claimed by Sir William Henry Preece, consulting engineer of the British post-office, that it is a practical, commercial system and that speaking has been accomplished at sea over a distance of eight miles without wires.

W. H. Caldwell & Son Co., Chicago, manufacturers of conveying and power transmission machinery, are decidedly progressive and up-to-date, especially in their treatment of their men. They are in favor of their employees reading mechanical papers, and to encourage them to subscribe they agree to pay one-half the subscription price which any man pays for his publication.

Mushet steel can generally be distinguished from the common variety by the emery-wheel test. Common cast steel, when ground on a dry emery-wheel, throws sparks of scintillating brightness while the debris flowing from Mushet steel under the same conditions are of a dull red with scarcely any incandescent sparks whatever.

One of Admiral Melville's latest plans for naval construction, which, however, has not been tried in practice, is to use three screws, with the engine that drives the middle one of half the total power. Each of the others will develop quarter the total power and there will thus be available relatively small engines for cruising speeds, with an immense surplus of power for emergency.

It appears that some manufacturers of automobiles have adopted the old scheme of having bolts and nuts made to no standard but their own, with the idea, presumably, of monopolizing all future repairs. The short-sightedness of this policy seems so evident that it is rather discouraging to find it is again being practised. The invariable result of such practices in the past has been to the detriment of the manufacturer. Any machine that cannot be easily repaired at a reasonable cost will eventually be abandoned for the type that fulfills these desirable conditions.

The genius of James Watt as an inventor apparently did not stop at his improvements of the steam engine. At the time of his death it is said that he was working on a machine for copying busts, carvings, etc. The original to be copied was held between the centers of a machine resembling a double spindle lathe, and the copy was held between the other pair of centers. The revolving motion of the two was timed alike and the form of the original was transferred to the other by a cutter held in a lever which was controlled by the shape of the model. It is thus apparent that this machine anticipated by many years the invention of Thomas Blanchard, but fortunately for the fame of Blanchard, Watt died before the machine was perfected.

It is estimated that twice as much work can be done for a given cost with mechanical traction as with horse-power, according to the experience of those who have been made a study of automobile work. It is singular to note, however, that Mr. Henry C. Morris, Philadelphia, has in his possession a proposal made by Oliver Evans to the Lancaster Turnpike Co., in which he shows that the cost of one journey from Philadelphia to Columbia, made in two days by the steam wagon, would be twenty-one dollars, while the same journey would require three days for the horse wagons, at a total cost of forty dollars. The cost of repairs he estimates as about the same for each wagon, say two dollars, and hence five times as much for the horse wagons as for the steam wagons.

Apart from the interest which attaches to an estimate of this nature made so very early in the history of steam traction, it is curious to note that the figures of Oliver Evans in 1804 agree proportionately almost exactly with those determined by experience at the present time.—"Engineering Magazine."

A simple method for finding the volume of a wooden pattern, or similar piece that cannot be immersed in water without damage, is to place it in a square box and fill it around with dry sand well shaken down until the box is evenly filled. Then by removing the pattern and leveling the sand, its cubic contents can be readily computed. Thus, if the box is 15" x 20" and 10" deep, the cubic contents are 3,000 cubic inches. If, after the pattern is removed, the level of the sand is found to be $6\frac{1}{2}$" high from the bottom, its cubical contents evidently are $3000 - (15 \times 20 \times 6\frac{1}{2}) = 1050$ cubic inches. Or multiply the length and breadth by the distance the sand lies from the top, thus: $15 \times 20 \times 3\frac{1}{2} = 1050$ cubic inches.

Such a pattern, if cast without cores, would weigh in cast iron, $1050 \times .261 = 274.05$ ounces or 17.12 pounds; in brass $1050 \times .304 = 319.2$ ounces or 19.95 pounds. The specific gravity of brass varies, however, somewhat according to the mixture, so the above can only be taken as about the average.

METHOD OF KEEPING TOOLS.

While on a call at the Worcester Polytechnic Institute recently, a scheme was noticed in the tool room for keeping the various tools that are hung on hooks like pipe wrenches, in their proper places. It is rather unique and seems well worthy of adoption where trouble is met in keeping such tools in their places. On the wall where each tool hangs, a figure of the tool belonging there, is painted in black and to the same scale. Thus the hooks for monkey wrenches have under them, silhouettes of such wrenches, but of varying sizes according to the actual size of the tool. The effectiveness of this simple scheme in keeping tools where they belong, goes without saying, especially where no regular attendant is employed.

It reminded the writer of the system described in the June issue of MACHINERY by which the Annamese toolkeeper in Marty & Abbadie's shop kept track of the tools borrowed, although the application is, of course, different. Such a system would undoubtedly be looked on with contempt by the average journeyman as being a kindergarten method for instructing in neatness, but just the same, its influence for keeping the tools in place would not be lost on anyone.

REMEDY FOR LOOSE FITS.

The "Railway Review" says: "A loose driving axle on a locomotive can be tightened by drilling a $1\frac{1}{4}$" hole in the center of the axle for the length of the wheel fit and driving into it a steel pin somewhat larger than the hole. The pin swells the axle so that it fills the wheel center tightly." While this scheme may work all right in some cases, especially on small iron axles, the process would not be so simple or easy with steel axles of 7" or 8" diameter. If a 7" axle was loose enough to "work" in the wheel center, it is fair to presume that to make it tight as it should be, its diameter should be increased by such an amount as would be needful to make a press fit. A conservative allowance for a press fit in this case would be .008." The steel pin would then have to increase the cubic measurement of the axle about $22 \times .004 \times 1 = .088$ cubic inches for each inch in length. To accomplish this increase, the steel pin would have to be, approximately, .044" larger in diameter than the hole into which it is forced. To prevent crushing, the pin should be made of tool steel and carefully hardened. Driving a pin in a hole under such conditions would be out of the question. A hydraulic press would undoubtedly be required to force it home.

NEW GAS ENGINE METHOD.

The "Engineering Magazine" calls attention to the fact that in order to obtain high economy in an internal combustion motor a high compression must be employed. In the ordinary gas or petroleum motor the limit to the compression is attained when the temperature of compression reaches the ignition temperature of the mixture of gas or vapor and air. If this ignition temperature is reached before the end of the compression stroke there will be a premature explosion, the motion will be reversed and the motor will fail to operate satisfactorily.

In the case of the Diesel motor this difficulty is avoided by compressing the air alone, and only injecting the liquid fuel at the moment when the combustion is desired, and this method also utilizes the heat of compression as an igniting device.

A still more recent invention is the motor designed by Prof. Donat Banke, Budapest, Austria. In this motor the charge of

mixed air and hydrocarbon vapor is drawn into the cylinder as usual, but with it is also mingled a fine spray of water. When the high compression is given to this mixture the water absorbs a portion of the heat of compression and thus the temperature may be kept below the ignition point. When the combustion does take place the conversion of the water into steam adds to the expansive power of the charge and thus aids in the power stroke, and at the same time the absorption of heat in the generation of this steam aids in keeping the cylinder from becoming overheated.

LARGE ATLANTIC LINERS.

That the Atlantic steamships will continue to grow in size and speed is suggested by the three great ships which are now being built, two of them at the Vulcan Yards, Stettin, for the North German Lloyd Company, and one by Harland & Wolff, at Belfast, for the White Star line. The particulars of these vessels and of the three famous vessels already constructed, the Kaiser Wilhelm der Grosse, the Oceanic, and the Deutschland, are given below:

Atlantic Steamships Built and Building.

Name.	Owners.	Length in feet.	Displacement in tons.	Horse power.	Speed in Knots.
Kaiser Wilhelm........	N. G. Lloyd............	649	20,000	28,000	22½
Oceanic..............	White Star.............	704	28,500	28.000	20½
Deutschland...........	Hamburg-American....	686	23,000	34.200	23
Kronprinz.............	N. G. Lloyd............	660	21,500	32,000	23
Kaiser Wilhelm II.....	N G. Lloyd............	705	26,000	38,000	23½
Unnamed..............	White Star..........	750	32.000	(?)	(?)

The North German Lloyd Company will place in service a vessel, the Kronprinz, which in size will come between the Kaiser Wilhelm and the Deutschland, and in speed will equal the latter. She will be 660 feet long, of 21.500 tons displacement, and is to show a sea speed of 23 knots with 32,000 horse-power. The other vessel, to be known as Kaiser Wilhelm II, is to be 705 feet long, of 26,000 tons displacement, with an indicated horse-power of 38,000, and is to maintain a sea speed of 23½ knots.—Scientific American.

THE DISAPPEARING GUN CARRIAGE BANISHED.

Following the decision of the naval board to adopt the superimposed turrets, comes the announcement that the army fortifications board have reported against the disappearing gun carriage for coast defense guns. If this results in the abolition of the disappearing gun carriage in future fortifications work, two of the most important events in the recent development of the navy and coast defenses are about to be inaugurated. The superimposed turrets, employed on the battleships Kearsage and Kentucky, were afterwards opposed by the board of naval officers and were not adopted for the next lot of battleships, of which the new Maine is one. After some changes in the board, however, and the successful trials of the main batteries of the Kentucky, this decision was reversed, and it is probable that in the future the superimposed turret system will be a feature of American-built ships of war.

It is said that the use of the disappearing gun carriage has been abandoned by all the powers of Europe because of the difficulty of providing for the recoil and the simultaneous lowering of the gun immediately after firing. In America, army officers have clung persistently to the idea of this form of carriage, as offering the best means of protection for the gun, not only because the gun is under the protection of the fortification except at the moment of firing, but because by its use it is possible to so conceal the fortification itself that its exact location will not be evident to an enemy until the battery has been fired. It was believed that American ingenuity could overcome the difficulty of the recoil and apparently it has done so in the Buffington carriage, which was evolved after a large expenditure of time and money.

It has not at this writing been announced why the fortifications board is opposed to the continuance of the disappearing carriage, but it is believed for one thing that it is too complicated for the average artillery officer to manage. Exhaustive investigations have been made relative to the subjects, both here and abroad. If this form of carriage is actually abolished, several machine shops will be deprived of some of the finest and most interesting machine work that has been done in this country.

AN OBJECT LESSON IN PROJECTION.

The small-tools department of the Pratt & Whitney Company have developed screw cutting with dies to an extent that probably is not generally appreciated, especially in the cutting of square-threaded screws with opening dies. The cutting of a square thread with a die is usually thought to be quite impracticable on account of the obvious difficulties of clearance and getting rid of the chips. That it is very successfully done, however, with this company's dies, is quite evident when samples of the work are examined. The writer's attention was called recently to some steel screws 1 5-16" in diameter and 30" long that had been cut with dies. The thread was square, 3-pitch, and slightly deeper than the width. The smoothness of the thread and sharpness of the angles were quite equal to lathe cut screws. They were done at the rate of 16 in 10 hours. The dies for these particular screws were made to order for a well-known manufacturing firm and in connection with the order a practical point was brought out that was somewhat puzzling to the parties interested.

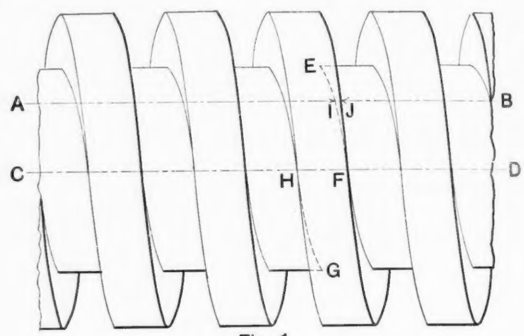


Fig. 1.

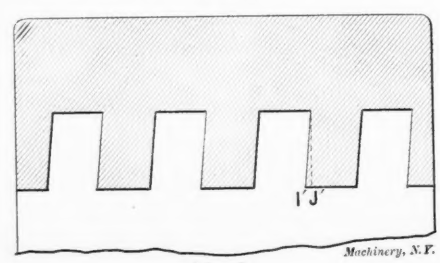


Fig. 2.

The dies had been carefully proved before shipping, but on their receipt, complaint was made that they were not as ordered, the claim being made that all the teeth of the dies were pitched and that none of the angles were right angles. A practical trial, however, showed that the dies were correct since they cut the required thread exactly as ordered in every respect.

The difficulty arose from a cursory examination of the dies before giving them a trial and the hasty judgment passed on them was one that would naturally have resulted with anyone who had never given the subject attention. The leading edges of the cutters were set ahead of the radial lines of the dies so, of course, the plane of intersection would be about as that shown in Fig. 1 along line A B. The cut is not to the same scale as the screw referred to, but is changed somewhat to accentuate the undercut of F E as seen at I J. The projection of a nut, Fig. 2, cut along the plane indicated by A B, shows the pitched position of the teeth very clearly. The pitch would obviously be much more pronounced if the plane of intersection were nearer the outside of the screw; and vice versa, it becomes less as the plane approaches the center until, at the center line C D, it is entirely eliminated.

From this it will be understood how important it is that a threading tool for cutting a square thread in the lathe should be set exactly on a level with the center of the work. Any deviation from this position, up or down, will prevent a tool that is squarely shaped from generating a truly square thread.

NEW TOOLS OF THE MONTH.

Under this heading are listed the new machine and small tools that have been brought out during the preceding month. Manufacturers are requested to send brief descriptions of their new tools as they appear, for use in this column.

A horizontal drilling machine is made by the B. F. Barnes Co., Rockford, Ill. It is designed for drilling holes in the ends of long pieces, such as in the end of a column or shaft. It will drill holes up to one inch diameter or tap holes up to ¾ inch diameter.

Prentice Bros., Worcester, Mass., have designed and built a massive two-spindle boring and drilling machine with vertical spindles. The spindles are mounted on a cross rail supported by two uprights, between which the work to be operated upon is placed, upon a suitable table. The machine will take work between the housings 10 feet wide and 8 feet high.

Among the new machines recently designed and built by Beaman and Smith, Providence, R. I., are three horizontal boring machines and a three-spindle milling machine. Of the boring machines, one, known as their No. 1 cylinder boring and facing machine, will bore 12 inches diameter, 24 inches long and face 20 inches diameter, both boring and facing being done simultaneously. The two others are of special design for large and massive work. One of these is suitable for boring work from 16 inches to 48 inches diameter up to seven feet long, and facing to 50 inches diameter. The other will bore and face cylinders nine feet long by 60 inches outside diameter. The milling machine is of the planer type and has two vertical spindles on the cross rail and one horizontal spindle. The table is 24 inches wide by eight feet long.

EIGHTEEN-INCH LATHE.

The Silk, Anderson Co., 429 East Second St., Cincinnati, O., have recently brought out an 18-inch "Cincinnati" lathe, built on the same general lines as their 16-inch and 20-inch lathes.

The screw feed reverse is on the outside of the head, where it is easily accessible for cleaning or repairs. By this construction the head stock is not weakened to make room for the reverse mechanism, nor is it necessary to remove the spindle to get at it. As the cone pulley, for driving the rod feed is on the spindle, it is not necessary to have the screw feed reverse gearing in operation, and consequently wearing, when operating with the rod feed.

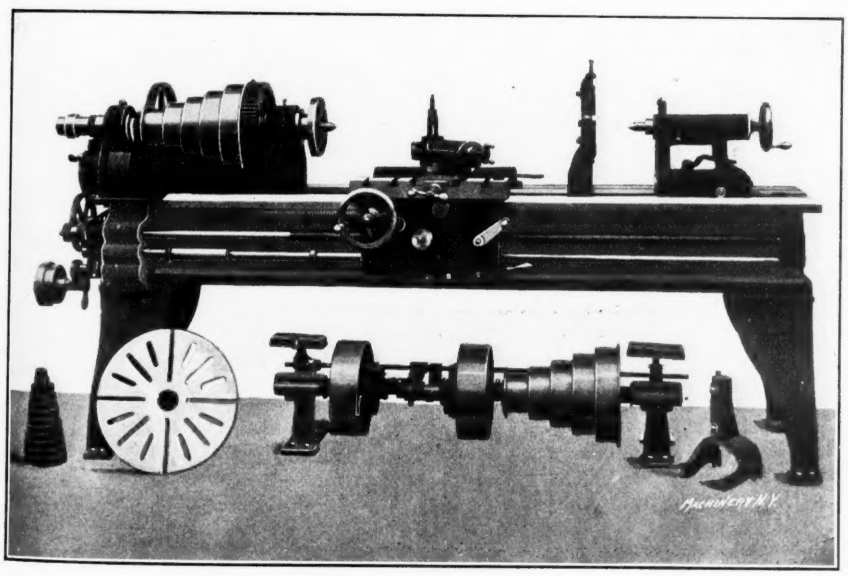


Fig. 1. Eighteen-inch Lathe built by Silk, Anderson Co.

The rod feed reverse is in the apron, and is so arranged that it is impossible to throw in the rod feed and the screw feed at the same time, one feed locking against the other.

The power cross feed and the longitudinal feed are each operated by friction discs. Either can be thrown in instantly, and both can be operated at the same time, if desired. The belt feed has four changes and an adjustable tightener and the feed rod can be operated by the screw feed gearing by simply engaging a slip gear. The compound rest and power cross feed each have micrometer adjustments. The design is heavy and powerful, but at the same time the convenience of the operator has been studied so that the lathe shall not be clumsy to operate. The front bearings are 2-15-16" x 5"; diameter of hole 1-9-16"; diameter of tail-stock spindle 1-15-16"; width of cone pulley steps 2-7-8".

GAS TEMPERING FURNACE.

The accompanying engraving shows a new gas furnace which is being manufactured by the Chicago Flexible Shaft Co., 158-

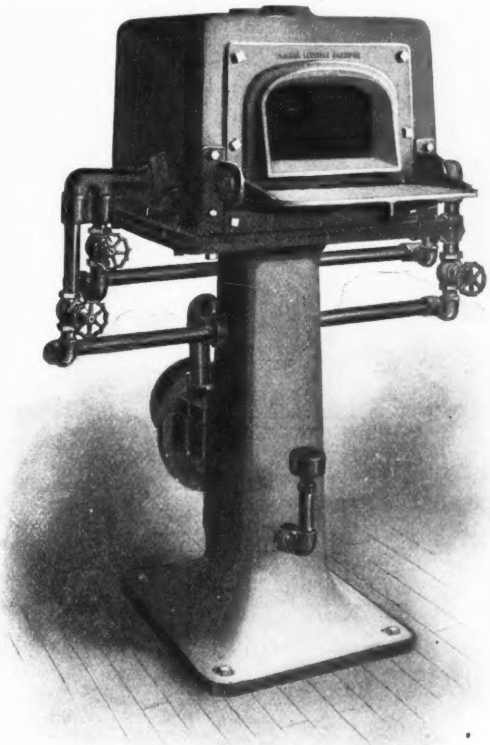


Fig. 2.

160 Huron street, Chicago. It is designed to meet the requirements of a tool room furnace, is especially adapted for heating tools, dies, taps, milling cutters, reamers, etc., and has a blower directly connected. The furnace is so arranged that the muffle can be removed and a clay slab substituted, transforming it into an oven furnace. The linings are extra heavy, reducing the radiation to a minimum. The gas and air-supply valves are so placed as to enable the operator to adjust them accurately. For all classes of work within its capacity this furnace offers an ideal method of heating. Entire seclusion from the products of combustion can be maintained, a feature of great importance to be considered when heating valuable tools. The cost of operating, using ordinary city gas, will not exceed five cents per hour. The furnace can be set up in any convenient place and belted direct from the main shaft. It will burn gasoline, illuminating or natural gas without soot or smoke.

The flame is projected from the burners into the chamber encircling the muffle. The lining is of such shape that a rotary motion is imparted to the flame, causing it to distribute itself evenly all over the enclosed space, the products of combustion being drawn off by the two small openings at the top of the chamber.

The degree of heat is under perfect control. The work is secluded from the products of combustion, a feature of great importance in heating dies and in milling cutters and other expensive tools. It is claimed that overheating can be entirely avoided and that difficult pieces can be hardened without danger of cracking, by reason of an even heat throughout.

RIVET HEATER—THE AMERICAN GAS FURNACE CO.

This furnace will heat rivets of any diameter up to ¾ inch, and not exceeding 3 inches in length. About 40 pounds are fed into the furnace in bulk and it will discharge one ¾-inch rivet per minute, or smaller rivets in proportionately less time. It takes 15 minutes to heat up the furnace, at the expiration of which time the first rivet can be withdrawn. The heater can be adapted to any kind of gas in ordinary use, including natural gas.

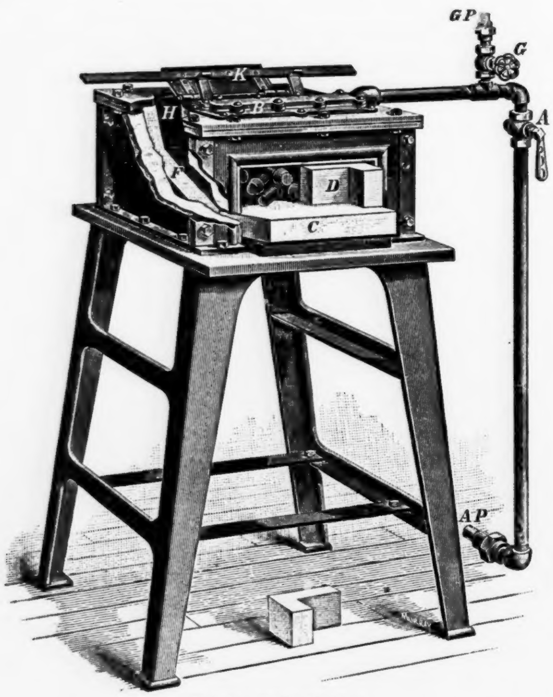


Fig. 3. Rivet Heater.

The air supply connects at A P and must be under the pressure of 1 pound to the square inch. The gas connects at G P and the pressure may be anything above 1 ounce, the supply being abundant. The rivets are fed through the feed hole H under the cover K. The furnace should be kept well filled and as the heated rivets are discharged new rivets should replace them so that the furnace never contains less than two-thirds of a full charge.

The bottom slab F is an inclined plane connecting with the horizontal slab C about 6 inches from the front of the furnace. On the slab C the actual heating is performed, while the rivets packed into the furnace and resting on the inclined plane are pre-heated by the waste heat, which passes through the charge to a vent at the feed hole.

The burner B emits numerous small flames downward upon the work, and as the heated rivets are removed from the slab C those back of them slide down the incline and take their place. The rapidity of heating can be controlled, as also the temperature of the rivets, which can be brought up to a bright cherry red or nearly white heat. The rivets are uniformly heated, and overheating is effectually prevented by proper adjustment of the gas and air valves.

This heater will be made in other sizes if desired. The builders are the American Gas Furnace Co., 23 John street, New York, who have also brought out an improved air-tempering furnace for tempering steel work of all kinds, but preferably small parts in quantities, especially where the stain from oil tempering is objectionable. Still a third new machine is a sand tempering furnace, for tempering steel by the action of heated sand or flint.

TOOL-ROOM LATHE.

A new tool-room lathe, 13-inch swing, is made by the Seneca Falls Mfg. Co., Seneca Falls, N. Y. It is of the well-known "Star" design, but is from entirely new patterns and of larger swing than heretofore built by this company.

The power is transmitted from the spindle to the feed rod entirely by gears, which are arranged for three different changes of speed. Changes can be made without stopping the machine. Both cross and longitudinal feeds can be operated independently or in combination as desired. The feeds are actuated by two phosphor-bronze worms on the feed rod, thereby securing the proper graduations of speed of the two feeds. All threads from three to 64 inclusive can be cut without compounding the gears and nearly all threads by compounding them. A taper attachment is furnished if desired and is fastened directly to the back of the carriage and travels with the carriage.

The head and tail stocks are of approved patterns. The former has a hollow spindle of crucible steel with phosphor bronze bearings and a four-step cone for a two-inch belt. The tail stock is cut away to allow room to operate the feed-screw handle, has a spindle with self-discharging center and an improved clamping device.

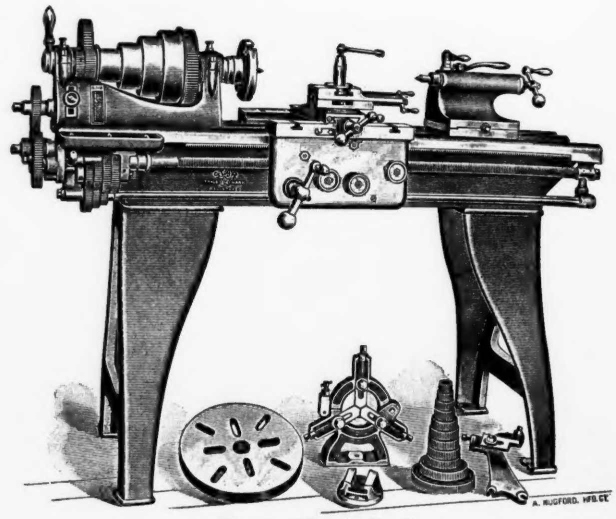


Fig. 4. "Star Lathe."

The carriage has T-slots for bolting on angle plates and can be locked to the bed when using the cross feed. Any of the usual rests are furnished as desired and center rest, follow rest, and all accessories are provided. The lathe is made in several lengths of bed, and with or without an oil pan, as ordered.

CENTERING MACHINE.

A two-spindle centering machine has been brought out by the Woodward & Rogers Co., Hartford, Conn., a cut of which is shown herewith. This machine has two spindles, one for the drill and one for the reamer, which are independent and run at different speeds. They revolve into position and are running only when the pulley is brought into contact with them, by the lever advancing them to the work.

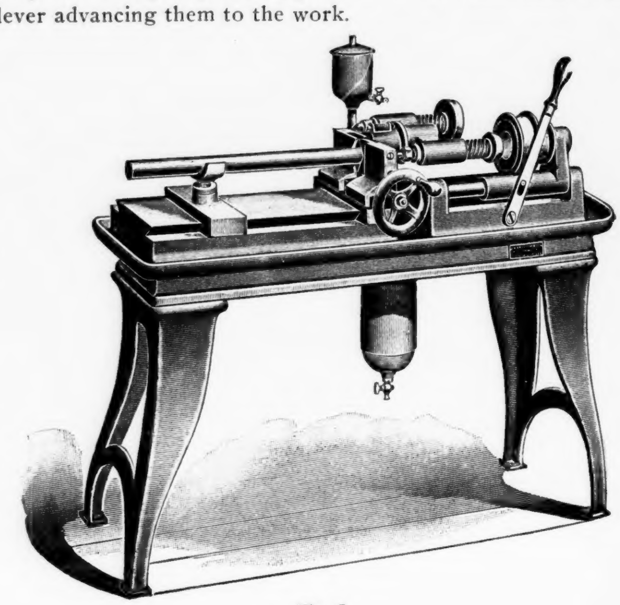


Fig. 5.

The work is held in a vise, having jaws operated by a right and left hand screw. The jaws hold one end central with the operating spindle and an adjustable rest, movable on the bed, holds the other end. The machine will take stock up to three inches diameter.

Two other new machines have been put on the market by this company, one a double-head traverse drill, for drilling holes up to 9-16 inch diameter. It has automatic feeds with ad-